

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of
Use of Spectrum Bands Above 24 GHz For
Mobile Radio Services
Establishing a More Flexible Framework to
Facilitate Satellite Operations in the 27.5-28.35
GHz and 37.5-40 GHz Bands
Petition for Rulemaking of the Fixed Wireless
Communications Coalition to Create Service
Rules for the 42-43.5 GHz Band
Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95,
and 101 To Establish Uniform License Renewal,
Discontinuance of Operation, and Geographic
Partitioning and Spectrum Disaggregation Rules
and Policies for Certain Wireless Radio Services
Allocation and Designation of Spectrum for
Fixed-Satellite Services in the 37.5-38.5 GHz,
40.5-41.5 GHz and 48.2-50.2 GHz Frequency
Bands; Allocation of Spectrum to Upgrade Fixed
and Mobile Allocations in the 40.5-42.5 GHz
Frequency Band; Allocation of Spectrum in the
46.9-47.0 GHz Frequency Band for Wireless
Services; and Allocation of Spectrum in the 37.0-
38.0 GHz and 40.0-40.5 GHz for Government
Operations

NOTICE OF PROPOSED RULEMAKING

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issuing separate statements.

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## I. INTRODUCTION

1. Today we take further steps to promote a flexible regulatory environment for the next generation of wireless services. In this *Notice of Proposed Rulemaking*, we continue our examination of higher frequency bands for mobile and other uses. In that regard, we identify specific spectrum bands above 24 GHz that appear to be suitable for mobile service, and we seek comment on proposed service rules that would authorize mobile and other operations in those bands. This development of service rules

for mobile use of the millimeter wave (mmW) bands occurs in the context of our efforts to develop a regulatory framework that will help facilitate so-called Fifth Generation (5G) mobile services.<sup>1</sup>

2. The framework we propose is built off of two decades of successful policies that stimulate and promote innovation and investment in wireless technologies and services. We propose rules that will enable flexibility in the uses and technologies that might be deployed in these bands in a way that also promotes coexistence between these different uses and technologies. We recognize that several of the bands we are examining are shared with satellite services, the Federal government, and fixed users. We believe it is possible to adopt a flexible and modern set of rules that can facilitate sharing among a wide variety of users and platforms. We propose to require flexible use commercial licensees to protect incumbent Federal operations consistent with Federal allocations in these bands, and expect that detailed sharing studies will be conducted as we consider development of the service rules for these bands to ensure that our proposed rules adequately protect Federal users.

3. In developing service rules for the mmW bands, we aim to facilitate access to spectrum, develop a flexible spectrum policy, and encourage wireless innovation. In order to ensure wide access to spectrum, we propose to use a variety of licensing mechanisms, including geographic area licenses, unlicensed operation under Part 15 of our rules, and authorizing indoor operating rights to property owners. In developing our technical rules, our goal is to develop flexible rules that will accommodate a wide variety of current and future technologies. Flexibility will also encourage innovation in the development of advanced wireless services using the mmW bands.

## II. EXECUTIVE SUMMARY

4. In this *Notice of Proposed Rulemaking*, we seek comment on the following proposals:
- 28 GHz and 39 GHz bands: We propose to authorize mobile operations in the 27.5-28.35 GHz band (28 GHz band) and the 38.6-40 GHz band (39 GHz band) with county-sized geographic area licenses. These bands could be suitable for deployment of high-capacity, high-throughput small cells as part of mobile broadband deployments. At the same time, we propose rules that would provide licensees with the flexibility to conduct fixed and/or mobile operations.
  - 64-71 GHz band: We propose to authorize operations in the 64-71 GHz band under Part 15 of our rules based on the rules we recently adopted for the adjacent 57-64 GHz band. This action will provide more spectrum for unlicensed uses such as Wi-Fi-like “WiGig” operations.
  - 37 GHz band: In the 37-38.6 GHz band (37 GHz band), we propose a hybrid licensing scheme that would grant operating rights by rule to property owners, while establishing geographic area licenses based on counties for outdoor use. This licensing mechanism would facilitate the deployment of advanced enterprise and industrial applications not suited to unlicensed spectrum or public network services, while also providing additional spectrum for more traditional cellular deployments.
  - Other Rules
    - We propose to grant mobile operating rights to existing fixed Local Multipoint Distribution Service (LMDS) and 39 GHz band licensees, and seek comment on utilizing an overlay auction as an alternative.

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<sup>1</sup> We note that we do not intend to define what qualifies as “5G”. Standard bodies like 3GPP and the International Telecommunications Union (ITU) plan to develop the requirements by early 2017. See [http://www.3gpp.org/news-events/3gpp-news/1674-timeline\\_5g](http://www.3gpp.org/news-events/3gpp-news/1674-timeline_5g).

- We propose to consider market-based rules that could facilitate greater satellite use of the 28 GHz, 37 GHz, and 39 GHz bands without unduly limiting terrestrial use of those bands.
- We seek comment on potential licensing approaches for the 28 GHz, 37 GHz, and 39 GHz bands. In particular, we seek comment on revising the performance requirements applicable to those bands.
- We seek comment on technical rules needed to facilitate licensed operation and mitigation methods to ensure protection of incumbent operations in the 28 GHz, 37 GHz, and 39 GHz bands.
- We propose to require mobile licensees to protect incumbent Federal operations, consistent with the Federal allocations in these bands. We seek detailed comment and analysis on ensuring compatibility between Federal uses and new mobile use of these bands, including comment on any rules that would be necessary to facilitate coexistence with Federal systems.
- We seek comment on how to ensure that effective security features are built into key design principles for communications devices and networks that will use these bands.

### III. BACKGROUND

#### A. The Millimeter-Wave Mobile Opportunity

5. Millimeter-wave frequencies have historically been considered unsuitable for mobile applications because of propagation losses at such high frequencies and the inability of mmW signals to propagate around obstacles. Technological advances holds promise in unlocking the potential of using mmW bands for mobile uses in a way that meets the need for flexible access to spectrum to improve bandwidth in constrained geographies. As discussed further below, short transmission paths and high propagation losses can facilitate spectrum re-use in microcellular deployments by limiting the amount of interference between adjacent cells. In addition, where longer paths are desired, the extremely short wavelengths of mmW signals make it feasible for very small antennas to concentrate signals into highly focused beams with enough gain to overcome propagation losses. The short wavelengths of mmW signals also make it possible to build multi-element, dynamic beam-forming antennas that will be small enough to fit into handsets – a feat that might never be possible at the lower, longer-wavelength frequencies below 6 GHz where cell phones operate today.

6. While the discussion concerning a possible fifth generation of mobile wireless technology includes a wide variety of ideas and technological developments, the possible use of mmW bands for mobile use is a key concept within that discussion. Many commenters point to the increasing demand for data from consumers using an ever wider variety of devices.<sup>2</sup> The mmW bands could be particularly useful in supporting very high capacity networks in areas that require such capacity. Several commenters also see the mmW bands being used for backhaul and machine-to-machine communication. Several commenters also highlighted that the low latency of 5G technology will enable various Internet of Things (IoT) applications including wearables, fitness and healthcare devices, autonomous driving cars, and home and office automation. In addition to the advanced antenna system, other enabling technologies for 5G include distributed network architecture, adaptive coding and modulation, multi-radio access technology, and advanced small cell technology.<sup>3</sup>

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<sup>2</sup> See CEA Comments at 3-5, CTIA Comments at 3-5, Intel Comments at 2-4.

<sup>3</sup> See <http://www.samsung.com/global/business-images/insights/2015/Samsung-5G-Vision-0.pdf>.

## B. Notice of Inquiry

7. In October 2014, acting on advice from the Commission's Technological Advisory Council, the Commission issued a *Notice of Inquiry* seeking comment on the prospects for provision of mobile radio services in the frequency bands above 24 GHz.<sup>4</sup> The *NOI* acknowledged the longstanding presumption that it would be infeasible to provide mobile services at such high frequencies but also took note of recent field trials in New York City and Austin, Texas, funded by the U.S. Army and Samsung, which appeared to demonstrate that non-line-of-sight services can be provided in the mmW bands by capturing reflections of signals that would otherwise be blocked by intervening obstructions.<sup>5</sup> The *NOI* further acknowledged work by other companies attempting to overcome line-of-sight limitations in frequency bands ranging from 5.8 GHz to as high as 72 GHz. Based on those and other developments, the Commission foresaw “a potential coalescence of technologies that could lead to the emergence of a new and radically more capable generation of wireless mobile service that can capitalize on use of the millimeter wave region of the spectrum around the year 2020.”<sup>6</sup>

8. The Commission also noted that significant momentum was starting to build among diverse countries and regions around the idea of a fifth generation of mobile and fixed services, that some envision as accommodating an eventual 1000-fold increase in traffic demand for mobile services; high-bandwidth content with speeds in excess of 10 gigabits per second (GB/s); end-to-end transmission delays (latency) of less than one-thousandth of a second, and, in the same networks, sporadic, low-data-rate transmissions among an “Internet of things”—all of this to be accomplished with substantially improved spectral and energy efficiency.<sup>7</sup> The *Notice* foresaw that achieving those objectives would likely require the development of new system architectures that, unlike current technologies, would necessarily include heterogeneous networks capable of delivering service through multiple, widely-spaced frequency bands and diverse types of radio access technologies, including macrocells, microcells, device-to-device communications, new component technologies, and unlicensed as well as licensed transceivers.<sup>8</sup> In that context, bands above 24 GHz were typically being considered not for stand-alone mobile services but as supplementary channels to deliver ultra-high speed data in specific places, as one component of service packages that will likely include continued use of lower bands to ensure ubiquitous coverage and continuous system-wide coordination.<sup>9</sup>

9. The *Notice* sought comment on the technologies underlying the development of mmW mobile services using bands above 24 GHz, the frequency bands that would be suitable for advanced mobile services, and the best ways to manage interference among operators and other licensees operating

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<sup>4</sup> In the Matter of Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, WT Docket No. 14-177, *Notice of Inquiry*, 29 FCC Rcd 13020, 13021 ¶ 2 (2014) (“*NOI*” or “*Notice*”).

<sup>5</sup> *NOI*, 29 FCC Rcd at 13024-13025 ¶¶ 5, 11. Those trials found that 39 GHz mobile base stations can sustain 100 percent coverage in cells with a 200-meter radius in high-density urban areas. Receivers equipped with highly directional, steerable antennas were able to capture and combine as many as 14 links with rooftop-mounted transmitters despite obstructions in propagation paths. *Id.*

<sup>6</sup> *NOI*, 29 FCC Rcd at 13025 ¶ 13.

<sup>7</sup> *NOI*, 29 FCC Rcd at 13023 ¶¶ 7, 9.

<sup>8</sup> *NOI*, 29 FCC Rcd at 13023 ¶ 7. Although many of these advanced technologies can be implemented in the fourth generation network as incremental modifications, substantial increase in network complexity may be introduced as the fundamental design of the current network architecture dates prior to the explosion in mobile broadband usage. The network architecture for fifth generation system can be designed to offer greater flexibility in networking, incorporating advanced elements of internet architecture into mobile networks, more efficient delivery of data, greater integration of cellular networks and Wi-Fi, and the ability to provide greater information to the network about devices and applications. *See generally* 4G Americas' Recommendation on 5G Requirements and Solutions, Section 3.3 at 15-18 (attached to 4G Americas Comments).

<sup>9</sup> *NOI*, 29 FCC Rcd at 13023 ¶ 7.

in the same or adjacent bands. Finally, the Commission sought comment on licensing and authorization schemes for mobile operations above 24 GHz.<sup>10</sup>

10. In its discussion of frequency bands above 24 GHz that would be most suitable for advanced mobile services, the *Notice* sought comment on the relative importance of access to large blocks of contiguous spectrum for successful implementation of advanced mobile technologies.<sup>11</sup> After reviewing the salient characteristics of several candidate bands, the *Notice* invited comment on the suitability of the three Local Multipoint Distribution Service (LMDS) bands between 27.5 and 31.3 GHz,<sup>12</sup> the 38.6-40 GHz band,<sup>13</sup> the 37-38.6 and 42-42.5 GHz bands,<sup>14</sup> the 57-64 and 64-71 GHz band,<sup>15</sup> the 71-76 GHz and 81-86 GHz bands,<sup>16</sup> and the 24.25-24.45 GHz and 25.05-25.25 GHz bands for advanced mobile services.<sup>17</sup> The Commission also invited comment on any other bands above 24 GHz that might be appropriate, including any bands above 95 GHz that could be suitable candidates for mobile services.<sup>18</sup>

11. Regarding licensing mechanisms, the Commission noted that, except for the 24 GHz band, all of the candidate bands mentioned above have existing mobile allocations,<sup>19</sup> and that the Commission has already established geographic service areas and conducted spectrum auctions for three of the bands – LMDS, 39 GHz, and 24 GHz.<sup>20</sup> The *NOI* inquired whether the Commission should upgrade the existing fixed service licenses for those bands to include authorization to provide mobile service.<sup>21</sup> Highlighting the unique characteristics of bands above 24 GHz, the Commission foresaw that base stations in bands above 24 GHz will likely have very small coverage areas; will likely have limited geographic coverage even in the aggregate, and will most likely be integrated into networks that will provide wide area coverage and network coordination in lower bands.<sup>22</sup> The Commission also said that whatever licensing regimes it adopts should take into account the fact that signals from carriers' outdoor base stations will rarely be able to penetrate into the interiors of buildings, where around 75 percent of cellular usage occurs.<sup>23</sup> The Commission also sought comment on a host of licensing options, technical rules, and other service rules.

### C. Recent Technological Developments

12. Since the release of the Commission's *NOI* in October 2014, there has been increased momentum behind the development of 5G technologies. Several manufacturers have showcased their

<sup>10</sup> See *NOI*, 29 FCC Rcd at 13026-13027 ¶¶ 16.

<sup>11</sup> *NOI*, 29 FCC Rcd at 13035 ¶ 49.

<sup>12</sup> *NOI*, 29 FCC Rcd at 13035-13037 ¶¶ 51-55.

<sup>13</sup> *NOI*, 29 FCC Rcd at 13037-13039 ¶ 56-61.

<sup>14</sup> *NOI*, 29 FCC Rcd 13039-13041 ¶¶ 62-69.

<sup>15</sup> *NOI*, 29 FCC Rcd at 13041-13042 ¶¶ 70-74.

<sup>16</sup> *NOI*, 29 FCC Rcd at 13042-13044 ¶¶ 75-82.

<sup>17</sup> *NOI*, 29 FCC Rcd at 13044-13045 ¶¶ 83-87.

<sup>18</sup> *NOI*, 29 FCC Rcd at 13035 ¶ 50.

<sup>19</sup> *NOI*, 29 FCC Rcd at 13045 ¶ 88.

<sup>20</sup> *NOI*, 29 FCC Rcd at 13045 ¶ 88.

<sup>21</sup> *NOI*, 29 FCC Rcd at 13045 ¶ 88.

<sup>22</sup> *NOI*, 29 FCC Rcd at 13045 ¶ 89.

<sup>23</sup> *NOI*, 29 FCC Rcd at 13045 at ¶ 90 and n.144, citing Real Wireless Ltd, The Business Case for Urban Small Cells, at 33 (Feb. 4, 2014) (analysis commissioned by Small Cell Forum) ([http://www.scf.io/en/documents/087\\_-\\_Business\\_case\\_for\\_urban\\_small\\_cells.php](http://www.scf.io/en/documents/087_-_Business_case_for_urban_small_cells.php)).

prototype 5G equipment operating in centimeter and millimeter wave bands.<sup>24</sup> In the United States, NYU Wireless Center has been leading the research in mmW technology, including the propagation measurements and models, radiation and biological health effects, mmW MAC layer design and other component technology development.<sup>25</sup> In July 2015, the National Institute of Standards and Technology (NIST) initiated the 5G Millimeter Wave Channel Model Alliance with companies, academia, and government organizations to support the development of more accurate, consistent, and predictive channel models.<sup>26</sup> Intel has introduced several laptop models with the 60GHz WiGig technology and continues to develop the mmW mobile broadband system in 28 GHz and 39 GHz bands. This is but some of the current and ongoing work on 5G technologies across the world.

#### D. World Radio Conference

13. The International Telecommunication Union's World Radiocommunication Conference (WRC) 2015 (WRC-15) is scheduled to take place from November 2-27, 2015 in Geneva, Switzerland.<sup>27</sup> One of the tasks of that conference is to set the agenda for the next WRC, which is expected to take place in 2019 (WRC-19). At WRC-15, the United States will support the study of spectrum requirements and potential identification of harmonized spectrum for mobile broadband below 6 GHz and will encourage the adoption of a plan for identifying spectrum for mobile technologies in higher frequency bands. At WRC-15, the United States is supporting the Inter-American Telecommunications Commission (CITEL) proposal to consider spectrum requirements and identification of bands for the terrestrial component of International Mobile Telecommunications (IMT) to facilitate mobile broadband applications, with the aim of reaching decisions regarding possible spectrum for mobile use at WRC-19. The proposals resolve to conduct sharing and compatibility studies, including adjacent band studies as appropriate, within the frequency ranges: 10-10.45 GHz,<sup>28</sup> 23.15-23.6 GHz, 24.25-27.5 GHz, 27.5-29.5 GHz, 31.8-33 GHz, 37-40.5 GHz, 45.5-47 GHz, 47.2-50.2 GHz, 50.4-52.6 GHz and 59.3-76 GHz.<sup>29</sup>

14. We recognize that other countries have proposed or will propose the identification of other bands for consideration for mobile broadband.<sup>30</sup> We are committed to working with both domestic and international partners in examining additional spectrum and on conducting the necessary technical sharing and compatibility studies. To the extent it becomes appropriate to consider additional bands for mmW mobile use in light of international developments, we will work with relevant stakeholders to examine the suitability of those bands for mobile and other uses.

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<sup>24</sup> See <http://www.mobileworldcongress.com/2015-exhibitors/>.

<sup>25</sup> See <http://nyuwireless.com/research/>.

<sup>26</sup> See <http://www.nist.gov/ctl/upload/5G-Millimeter-Wave-Channel-Model-AllianceV2.pdf>.

<sup>27</sup> See <http://www.itu.int/en/ITU-R/conferences/wrc/2015/Pages/default.aspx>.

<sup>28</sup> The band 10-10.45 GHz applies only to countries listed in ITU Radio Regulations footnote 5.480. See ITU RR5.480.

<sup>29</sup> See CITEL Agenda Item 10 – Future Conference Agenda Items, Topic K: IMT in bands above 6 GHz, Document Doc. 4000-10K-6GHz, available at <https://www.fcc.gov/encyclopedia/citel-inter-american-proposals-iap>.

<sup>30</sup> See, e.g., 5th Meeting of the APT Conference Preparatory Group for WRC-15 (APG15-5), “Preliminary common proposals on WRC-15 Agenda Item 10”, Document APG15-5/OUT-40 at [http://www.appt.int/sites/default/files/2015/08/APG15-5-OUT-40\\_PACP\\_AI10.docx](http://www.appt.int/sites/default/files/2015/08/APG15-5-OUT-40_PACP_AI10.docx). See also 8th meeting of the Conference Preparatory Group Project Team A, “European Common Proposals for the Work of the Conference”, PTA-TEMP-48, 19 August 2015 at [http://www.cept.org/Documents/cpg-pt-a/26610/CPG-PTA\(15\)145-Annex-V-34r1\\_-AI10-Draft-ECP](http://www.cept.org/Documents/cpg-pt-a/26610/CPG-PTA(15)145-Annex-V-34r1_-AI10-Draft-ECP).

## IV. DISCUSSION

### A. Bands Above 24 GHz for Mobile Use

#### 1. Criteria for Examining Bands for Mobile and Other Uses

15. *Background.* In the *NOI*, we specifically sought comment on the suitability of the following bands for mobile use: the Local Multipoint Distribution Service (LMDS) band (27.5-28.35 GHz, 29.1-29.25 GHz, and 31.0-31.3 GHz), the 39 GHz band, the 37 GHz band and 42-42.5 GHz, 57-64 GHz and 64-71 GHz bands, the 70/80 GHz bands (71-76 GHz and 81-86 GHz), and the 24 GHz bands (24.25-24.45 GHz and 25.05-25.25 GHz).<sup>31</sup> We also invited comment on any other band that might be appropriate for mobile services, including bands above 95 GHz.<sup>32</sup> We asked commenters “to explain the characteristics that enable mobile services, the nature and extent of incumbent services, and steps that can be taken to ensure incumbent uses are protected.”<sup>33</sup>

16. Commenters highlight several characteristics that they believe are important elements of defining a band as suitable for mobile use. Several commenters discuss the need for a substantial amount of contiguous bandwidth in order to enable 5G services. NYU Wireless and Qualcomm suggest a minimum channel bandwidth of 500 megahertz of contiguous spectrum will be necessary.<sup>34</sup> TIA states, “Aggregation of spectrum from several hundred MHz to even 1 GHz may be essential to promote next-generation wireless networks.”<sup>35</sup> Nokia suggests at least 300 megahertz of contiguous spectrum is needed.<sup>36</sup> Huawei suggests 1-2 GHz of spectrum may be necessary to provide 100 MB/sec throughput.<sup>37</sup> Avanti and the European Satellite Operator’s Association (ESOA) assume a minimum necessary bandwidth of 1 GHz.<sup>38</sup> On the other hand, Ericsson suggests that 100-200 megahertz blocks may be appropriate for the 28 GHz band, although it recommends 500 megahertz blocks for the 37 GHz and 39 GHz bands.<sup>39</sup>

17. Equipment manufacturers and others also highlight the benefits of having internationally harmonized spectrum. Ericsson writes, “Global harmonization will limit the number of models of equipment required to be developed, making each cheaper and more affordable for operators to deploy.”<sup>40</sup> 4G Americas, CEA, Samsung and TIA also believe that international harmonization will be essential to the success of the next generation of networks.<sup>41</sup> Additionally, Qualcomm notes the benefits of global harmonization, although it does not believe that the Commission should refrain from establishing service rules for mobile use just because other countries do not plan to authorize mobile service in that band.<sup>42</sup>

18. In the *NOI*, we sought “to advance our understanding of the means by which mobile services can avoid interfering with each other and with incumbent services and users that may share the

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<sup>31</sup> *NOI*, 29 FCC Rcd at 13035-13045 ¶¶ 51-87.

<sup>32</sup> *NOI*, 29 FCC Rcd at 13035 ¶ 50.

<sup>33</sup> *NOI*, 29 FCC Rcd at 13035 ¶ 50.

<sup>34</sup> NYU Comments at 56, Qualcomm Comments at 12.

<sup>35</sup> TIA Comments at 3.

<sup>36</sup> Nokia Comments at 27.

<sup>37</sup> Huawei Comments at 13-14.

<sup>38</sup> Avanti Comments at 4, ESOA Comments at 4.

<sup>39</sup> Ericsson Comments at 37-38.

<sup>40</sup> Ericsson Comments at 35.

<sup>41</sup> 4G Americas Comments at 6-7, CEA Comments at 11, Samsung Comments at 17, TIA Comments at 4.

<sup>42</sup> Qualcomm Comments at 16.

same frequency bands as well as the impact on adjacent band radio services.”<sup>43</sup> Commenters agree that the Commission must consider existing incumbent uses in determining whether a particular band is a good candidate for mobile use.<sup>44</sup> The only commenter that advocates for removal of an existing service or allocation in any of the bands under consideration in the *NOI* is Straight Path, which asked the Commission to remove the Fixed Satellite Service (FSS) allocation in the 39 GHz band.<sup>45</sup>

19. There were four categories of incumbents (or organizations representing incumbent interests) that commented in this proceeding. Many incumbent geographic area licensees with fixed operating rights expressed support for authorizing mobile use in their bands, especially if the incumbent licensees were given the mobile operating rights.<sup>46</sup> Satellite interests highlighted their interest in protecting current and future use of the Ka-Band and V-Band.<sup>47</sup> Commenters that use the mmW bands for fixed uses ask the Commission to prioritize, or, at a minimum, allow for continued fixed use of these bands.<sup>48</sup> Finally, the Committee on Radio Frequencies (CORF) asked the Commission to keep protection of adjacent-channel operations in mind when selecting mmW bands for mobile use.<sup>49</sup>

20. *Discussion.* We believe there are four main criteria we should use in evaluating the suitability of mmW bands for mobile use in this *NPRM*. First, for purposes of this *NPRM*, we will focus on bands with at least 500 megahertz of contiguous spectrum. While commenters have offered a variety of minimum bandwidths that will be needed to accommodate mmW mobile use, virtually all commenters agree that it will be easier to accommodate mobile use in wider bands. Given the nascent state of mmW mobile technology, we believe our initial efforts should be focused on the band where the most spectrum is potentially available. Specifically, we will consider the 27.5-28.35 GHz band (28 GHz band), the 38.6-40 GHz band (39 GHz band), the 37-38.6 GHz band (37 GHz band), and the 64-71 GHz band. We note that we may consider additional bands in the future, and the fact that a particular band or bands are not considered in this *NPRM* does not foreclose future Commission action on the band or bands.

21. Second, to the extent practical, we propose bands that are being considered internationally for mmW mobile service. While uniform international harmonization will not be possible because different countries have different spectrum frameworks and needs, substantial international harmonization would help promote development of mmW mobile service by reducing development and equipment costs and promoting a unified world market. For purposes of this *NPRM*, we will focus on those bands that have existing mobile allocations. We will also work with other countries through the International Telecommunications Union (ITU), in particular the World Radio Conference (WRC), and other processes to promote harmonized spectrum assignments for mmW mobile use.

22. Third, mobile use in mmW bands should be compatible with existing incumbent license assignments and uses. Current licensees that choose to continue their existing, authorized services should be able to do so. In applying that criterion, we do not mean to suggest that incumbents are entitled to

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<sup>43</sup> *NOI*, 29 FCC Red at 13021 ¶ 2.

<sup>44</sup> See, e.g., CEA Comments at 9-10 (“[T]he FCC should provide adequate protection to incumbents that are already utilizing the mmW bands, as well as to promote their expansion of services, while facilitating the widest possible range of future uses.”); NYU Wireless Comments at 31 (“We further support protecting incumbent operations and considering them as part of any potential service rules.”); TIA Comments at 2 (“Good spectrum policy decisions need to be made on a band-by-band basis, depending on the particular propagation characteristics of a band, existing service allocations, and existing incumbent services within a band.”)

<sup>45</sup> Straight Path Comments at 19-21.

<sup>46</sup> See FiberTower Comments, Straight Path Comments, XO Comments.

<sup>47</sup> See Avanti Comments, EchoStar Comments, ESOA Comments, Satellite Parties Comments, O3b Comments, SIA Comments, ViaSat Comments.

<sup>48</sup> See Bluwan SA Comments, FWCC Comments, McKay Brothers Comments, Vivint Wireless Comments.

<sup>49</sup> See, e.g., CORF Comments at 4-5.

maintain the *status quo* indefinitely. Specifically, many of the bands under discussion have shared allocations with satellite. As part of this *NPRM*, we will examine possible means of allowing enhanced satellite use of shared bands. We must also take into account the use of these bands for backhaul and other point-to-point purposes. These frequencies are well suited for backhaul and other fixed point-to-point uses because it is possible to have small, highly directional antennas in these bands which, together with the shorter propagation ranges, facilitate extensive reuse microwave frequencies in the same geographic area.<sup>50</sup> The Commission has noted that “[i]n certain rural and remote locations, microwave is the only practical high-capacity backhaul solution available.”<sup>51</sup>

23. Finally, it is important to establish a flexible regulatory framework that accommodates as wide a variety of services as possible. We recognize that there is much that is unknown about all future uses of the mmW bands. Equipment manufacturers, including Ericsson, Alcatel-Lucent and Huawei all claim that substantial further research and development is required, and that the mmW bands may always present substantial challenges to the provision of mobile service.<sup>52</sup> Thus, even among telecommunications equipment manufacturers, there is not an overwhelming consensus on the record that terrestrial mobile services will rapidly proliferate in the mmW bands in the near future. Similarly, particularly with respect to V-Band, satellite interests do not point to any firm commitments or plans to use that band.

24. We believe the appropriate response to the uncertainties is to establish a regulatory framework that maximizes flexibility and enables the widest possible variety of services, consistent with the state of technology and the characteristics of the mmW bands. A variety of commenters support expeditious issuance of an *NPRM* to help advance consideration of mobile technologies as part of the WRC process.<sup>53</sup> We observe that certain satellite and terrestrial interests argue that we should not consider steps to facilitate the other type of service because it is speculative whether the other service will develop or premature to know how or when the other service will develop.<sup>54</sup> We reject that approach.

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<sup>50</sup> For an example of how microwave spectrum can be reused in an area, see Amendment of Part 101 of the Commission's Rules to Facilitate the Use of Microwave for Wireless Backhaul and Other Uses and to Provide Additional Flexibility to Broadcast Auxiliary Service and Operational Fixed Microwave Licensees, WT Docket No. 10-153, *Report and Order, Further Notice of Proposed Rulemaking and Memorandum Opinion and Order*, 26 FCC Rcd 11614, 11640 ¶ 61 (2011) (graphic showing reuse of 6 GHz band in Los Angeles area).

<sup>51</sup> *Id.* at 11616 ¶ 1.

<sup>52</sup> Ericsson Comments at 6 (“Propagation limitations will greatly limit non-line of sight coverage, especially in rural and suburban areas where line of sight is not augmented by reflective paths.”); Alcatel-Lucent Comments at 10 (“Coupled with blocking effects, one can expect the connectivity to be rather intermittent with frequent searches for new beam directions required to maintain the link”); Huawei Comments at 7 (“For mobile services, limits of propagation and obstruction at these millimeter wave frequencies will diminish practicality of millimeter wave systems to low-level small cells”).

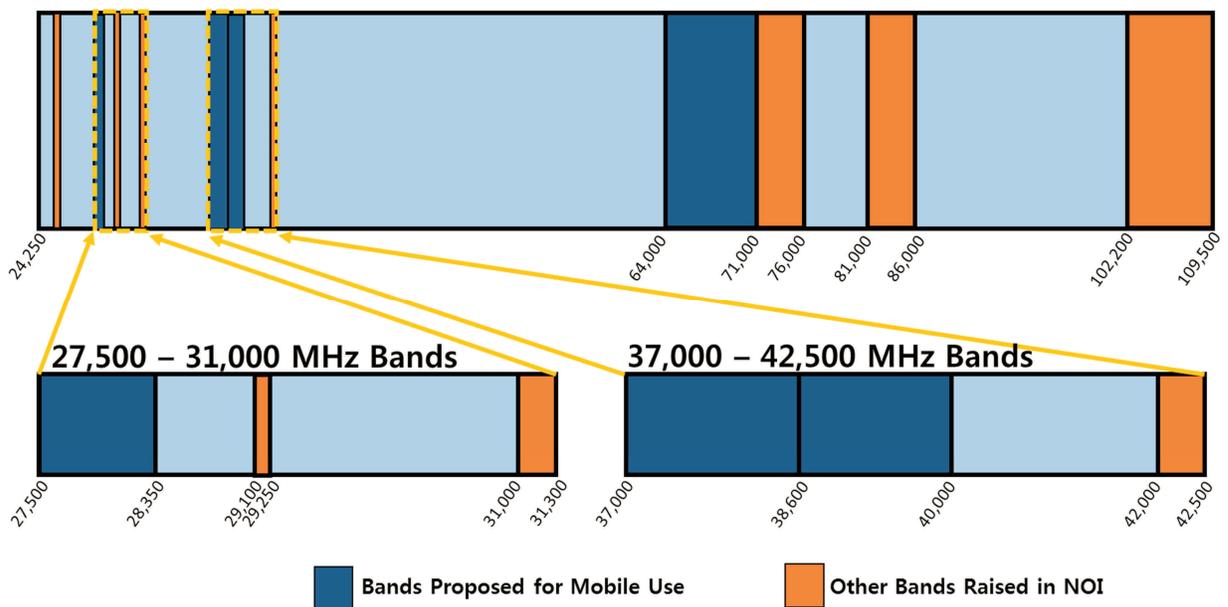
<sup>53</sup> See, e.g., Letter from Russell H. Fox, Esq. and Stephen J. Wang, Esq., counsel for Straight Path Communications, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission (filed Sep. 11, 2015) (Straight Path Sep. 11 *Ex Parte*); Letter from Robert Kubik, Ph.D., Director, Public Policy, Engineering and Technology, Samsung Electronics America, Inc. and Samsung Research America to Marlene H. Dortch, Secretary, Federal Communications Commission (filed Aug. 28, 2015) at 1 (Samsung Aug. 28 *Ex Parte*); Intel Corporation, Recommendations on the Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, *Ex Parte* (filed Aug. 10, 2015) at 1-2 (Intel Aug. 10 *Ex Parte*).

<sup>54</sup> See, e.g., SIA Reply Comments at 10 (“It would be premature to make any decisions concerning licensing regimes for possible mobile services in the bands above 24 GHz”); EchoStar Comments at 4 (“The FCC should not move forward with sharing for 5G services in frequency bands where there not a sufficient technical basis available to create a regulatory framework”); Straight Path Reply Comments at 16 (it would be “premature” to reserve V-Band for “speculative satellite uses”); Letter from Tom Stroup, President, Satellite Industry Association to Marlene H. Dortch, Secretary, Federal Communications Commission (filed Aug. 28, 2015); Letter from Jennifer A. Manner,

(continued....)

Waiting to develop a regulatory framework would have several disadvantages. First, given the rapid pace of technological development in these bands, waiting to develop service rules could result in delays in service if we are unable to finalize rules in a timely fashion. Such delays could affect the United States’ leadership in mobile communications and hurt consumers.<sup>55</sup> Second, establishing a regulatory framework now will provide equipment manufacturers and service providers with specific guidance as they design equipment and service offerings. In contrast, doing nothing will make it more difficult to plan for any type of service in the mmW bands. Third, creating a flexible regulatory framework would be consistent with the Commission’s general policy of technological neutrality, which has wide support among commenters.<sup>56</sup> Accordingly, we are attempting to develop rules that will accommodate the widest possible variety of services. In choosing bands for mmW mobile use, we will prioritize bands where it is possible to develop a flexible framework that accommodates the widest possible variety of services. The graphic below summarizes our consideration of various bands in this item:

### Bands Above 24 GHz for Possible Mobile Use



(Continued from previous page) \_\_\_\_\_  
 Vice President, Regulatory Affairs, EchoStar Satellite Operating Corporation to Ms. Marlene H. Dortch, Secretary, Federal Communications Commission (filed Sep. 15, 2015).

<sup>55</sup> See, e.g., AT&T Reply Comments at 2-5 (delays in authorizing cellular service in the United States allegedly cost American consumers up to \$100 billion and resulted in Ericsson and Nokia becoming “industrial giants.”)

<sup>56</sup> See EchoStar Comments at 11, *citing* Amendment of Part 27 of the Commission's Rules to Govern the Operation of Wireless Communication Services in the 2.3 GHz Band, Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band, *Report and Order and Second Report and Order*, 25 FCC Record 11710, ¶ 28 (2010) (“[C]onsistent with the Commission's long-standing policies of maintaining technical and service neutrality in its rules and allowing flexible spectrum use by licensees, we adopt rules that remain technology neutral instead of adopting rules that mandate the use of a particular technology or service.”) See also Wireless Innovation Forum Comments at 4-5 (urging the Commission to make technology and application neutrality a key aspect of its rules because the technologies in the mmW wave bands are evolving rapidly, “at Internet speed,” much faster than the timescales used in administrative law and rulemakings.”).

## 2. Bands Proposed for Mobile Use

### a. 27.5-28.35 GHz Band

25. *Background.* In 1997, the Commission developed a band plan making 1,300 megahertz of LMDS spectrum in each basic trading area (BTA) across the United States.<sup>57</sup> Specifically, the Commission allocated two LMDS licenses per BTA—an “A Block” and a “B Block” in each.<sup>58</sup> The A Block license is comprised of 1,150 megahertz of total bandwidth, and the B Block license is comprised of 150 megahertz of total bandwidth.<sup>59</sup> The A Block consists of the sub bands 27.50-28.35 GHz (the A1 Band); 29.10-29.25 GHz (the A2 Band); and 31.075-31.225 GHz (the A3 Band).<sup>60</sup> The B Block consists of the sub bands 31.00-31.075 (the B1 Band) and 31.225-31.30 GHz (the B2 Band).<sup>61</sup> Of the 986 designated license areas (493 BTAs times two licenses per BTA), 416 areas have active licenses, which cover about 75 percent of the U.S. population.

26. LMDS occupies portions of two spectrum bands that the Commission has allocated on a co-primary basis for Fixed and Mobile services, as reflected in the U.S. Table of Frequency Allocations.<sup>62</sup> While the Commission has not, to date, authorized any specific service (including LMDS) to provide mobile service in those bands, it previously expressed an expectation that it would expand the LMDS authorization for Fixed Service to include Mobile Service if proposed and supported by the resulting record. In the *Second LMDS Report & Order*, the Commission stated:

To ensure the flexibility in LMDS service offerings that commenters seek and we proposed, we will permit any fixed terrestrial uses that can be provided within the technical parameters for LMDS. We conclude that, for now, our significant allocation of spectrum under such a broad and flexible service definition should permit licensees to satisfy a broad array of their customers' communications needs, whether through one or multiple service offerings. Although LMDS is allocated as a fixed service, we know of no reason why we would not allow mobile operations if they are proposed and we obtain a record in support of such an allocation. We believe this would be consistent with our goal of providing LMDS licensees with maximum flexibility in designing their systems. We have authorized other wireless services to include mobile and fixed services, depending on whether developments in the service and related equipment demonstrate a need for changing the rules and a capability for mobile and fixed services to coexist in these bands.<sup>63</sup>

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<sup>57</sup> See Rulemaking to Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies For Local Multipoint Distribution Service and For Fixed-Satellite Services, CC Docket No. 92-297, *Second Report and Order, Order on Reconsideration and Fifth Notice of Proposed Rulemaking*, 12 FCC Rcd 12545, 12605 ¶ 136 (1997) (“*Second LMDS Report and Order*”); see also Rand McNally Commercial Atlas & Marketing Guide 36-39 (123rd ed. 1992). Rand McNally is the copyright owner of the Major Trading Area (MTA) and BTA Listings, which list the BTAs contained in each MTA and the counties within each BTA, as embodied in Rand McNally's Trading Area System MTA/BTA Diskette, and geographically represented in the map contained in Rand McNally's Commercial Atlas & Marketing Guide. The conditional use of Rand McNally copyrighted material by interested persons is authorized under a blanket license agreement dated February 10, 1994 and covers use by LMDS applicants. This agreement requires authorized users of the material to include a legend on reproductions (as specified in the license agreement) indicating Rand McNally ownership. The Commission has allocated the LMDS for operations in a total of 493 BTAs throughout the nation.

<sup>58</sup> See *Second LMDS Report and Order*, 12 FCC Rcd at 12556 ¶ 12.

<sup>59</sup> See *id.*

<sup>60</sup> See 47 C.F.R. § 101.1005.

<sup>61</sup> See *id.*

<sup>62</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>63</sup> *Second LMDS Report & Order*, 12 FCC Rcd at 12637 ¶ 207.

27. There are no primary Federal allocations in the 28 GHz band. For the 28 GHz band, the U.S. Table of Frequency Allocations includes a co-primary Fixed Satellite Service (FSS) Earth-to-space allocation,<sup>64</sup> but section 25.202 of the Commission's rules provides that FSS is secondary to LMDS in that band.<sup>65</sup> Twenty stations are licensed for Earth-to-space transmissions on a secondary basis in the 28 GHz band, and there are nineteen pending applications for operation in this band.<sup>66</sup>

28. Ericsson, Motorola, Samsung, Straight Path, and XO support allowing mobile use in the LMDS bands.<sup>67</sup> They point to the Commission's prior statement that it would allow mobile operations if the record supported such an action.<sup>68</sup> Ericsson describes the LMDS band as being "of particular interest" for mobile services.<sup>69</sup> Most satellite interests, including Avanti, ESOA, the FSS Operators, Inmarsat, and O3b argue that mobile use of the 28 GHz band is incompatible with existing use of the Ka-Band by satellite systems.<sup>70</sup> They argue that satellite operators need regulatory certainty that they will have spectrum available in order to make the large investments needed to construct and deploy satellites.<sup>71</sup> SES, Intelsat, O3b, and Inmarsat argue that the operation of certain types of FSS earth stations, such as gateway earth stations, in the 28 GHz band (Earth-to-space) should have primary status.<sup>72</sup> EchoStar, Hughes Network Systems and Alta Wireless also suggest that consideration be given to granting co-primary status to the operation of gateway earth stations in the 28 GHz band.<sup>73</sup> Some parties argue that the 28 GHz band is not a good candidate for mobile use because the U.S. LMDS band plan does not align with international use of the band.<sup>74</sup> Inmarsat states that it lacks sufficient information to determine whether contemplated mobile systems would be compatible with existing satellite use.<sup>75</sup>

29. Not all satellite operators oppose consideration of the 28 GHz bands for mobile use. EchoStar supports giving existing LMDS licensees the flexibility to provide mobile services along with upgrading the status of gateway earth stations in the band to co-primary.<sup>76</sup> ViaSat "urges the Commission to refrain from defaulting to outdated paradigms for sharing between satellite and terrestrial systems" and urges the Commission to expand the ability of satellite operators to make "opportunistic" use of bands such as the 28 GHz band.<sup>77</sup>

30. *Discussion.* We propose to authorize mobile operation in the 28 GHz band. The research conducted by Samsung, NYU Wireless, and others demonstrates that mobile technologies can

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<sup>64</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>65</sup> 47 C.F.R. § 25.202(a)(1) n.2.

<sup>66</sup> On September 4, 2015, the Commission's IBFS database listed 20 FSS Earth-to-space licenses for the 27.5-28.35 GHz band and 19 pending applications.

<sup>67</sup> EchoStar Comments at 22-24, Ericsson Comments at 37, Motorola Comments at 7, Samsung Aug. 28 *Ex Parte* at 2, Straight Path Comments at 15-17, XO Comments at 3.

<sup>68</sup> EchoStar Comments at 22 n.61, Straight Path Comments at 16, XO Comments at 4.

<sup>69</sup> Ericsson Comments at 37.

<sup>70</sup> Avanti Comments at 2; ESOA Comments at 2, FSS Operators Comments at 2, Inmarsat Comments at 4-5, O3b Comments at 10.

<sup>71</sup> Avanti Comments at 2, ESOA Comments at 2, O3b Comments at 10.

<sup>72</sup> FSS Operators Comments at 4.

<sup>73</sup> EchoStar Comments at 24, EchoStar Reply Comments at 6.

<sup>74</sup> Avanti Comments at 6, Inmarsat Comments at 6.

<sup>75</sup> Inmarsat Comments at 5.

<sup>76</sup> EchoStar Comments at 22-24.

<sup>77</sup> ViaSat Comments at 8-10.

theoretically work in this band.<sup>78</sup> Furthermore, the availability of 850 megahertz of contiguous spectrum makes this band particularly attractive for potential mobile use. Mobile use would be consistent with existing fixed uses in this band. Indeed, XO and Straight Path, which are LMDS licensees, support authorizing mobile use in this band. As we will discuss in further detail below, we propose to grant existing LMDS licensees mobile rights, which will facilitate coordination between fixed and mobile uses in the band.

31. We have carefully considered the opposition from certain satellite interests to allowing mobile use in this band, but tentatively conclude that those parties have not presented a valid basis for rejecting mobile use in this band. While those parties argue that they need regulatory certainty in order to invest in their systems, authorizing mobile use would not deprive FSS operators of any reasonable expectations they had of access to spectrum. Under our current rules, FSS use of this band is secondary to LMDS.<sup>79</sup> Furthermore, this band has a co-primary mobile allocation throughout the world.<sup>80</sup> The investments satellite operators have made in Ka-band operations were made with knowledge of their secondary status. The primary reason there has been little discussion of mobile use in this band is that there has not been any technology that would allow for mobile use of the millimeter wave bands such as this one. As that technology develops, it is unreasonable for us to preclude mobile use of this band solely because of pre-existing secondary use. Finally, we note that the satellite operators that oppose use of the 27.5-28.35 GHz band do not propose a comparable alternative band for mobile use.

32. We also reject the argument that the 28 GHz band should not be considered for mobile use because the U.S. band plan has not been replicated in other countries. While we recognize the benefits of international harmonization, we also understand that not every country will be able to designate exactly the same bands for similar uses because they will have a different needs and incumbent uses. We note that international equipment vendors such as Samsung, Huawei, and Alcatel-Lucent are looking at this frequency range for mobile use. Furthermore, the worldwide co-primary mobile allocation for this band is also an important factor that supports mobile use of this band.

33. Most importantly, we do not view mobile use of this band as necessarily being inconsistent with continued satellite use of the band. Our goal in this proceeding is to establish a flexible regulatory framework that accommodates as wide a variety of uses as possible. The Commission has recognized that satellite technology “is particularly important for communication in remote areas that are unserved or underserved by terrestrial communication facilities” and can provide vital connectivity for first responders in emergencies and natural disasters.<sup>81</sup> Satellites are being used to provide communications services such as satellite television to homes and two-way voice and data networks (including broadband services).<sup>82</sup> In light of these important services, we agree with ViaSat that it is time to reexamine “outdated paradigms” and closely examine potential opportunities for sharing. Satellite operators agree that they have been able to coordinate use with existing fixed LMDS licensees. While mobile use presents additional challenges in terms of coexistence, we offer proposals and ask questions about our ability to expand non-federal, secondary satellite use of this band by granting them, through a market-based mechanism, the right to greater flexibility in their use of the band. As discussed below, this proposed market-based mechanism would enable non-Federal satellite users to obtain the terrestrial

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<sup>78</sup> Samsung Comments at 20-24, NYU Wireless Comments at 20-24.

<sup>79</sup> See 47 C.F.R. § 25.202(a)(1) n.7.

<sup>80</sup> See 47 C.F.R. § 2.106 (United States Table of Allocations).

<sup>81</sup> See Comprehensive Review of Licensing and Operating Rules for Satellite Services, *Report and Order*, IB Docket No. 12-267, 28 FCC Rcd 12403, 12405 ¶ 2 (2013).

<sup>82</sup> *Id.*

licenses in the band, by either participating in a Commission auction or through the secondary market, in order to achieve co-primary status and thereby obtaining greater flexibility in their use of the band.<sup>83</sup>

34. At a minimum, we anticipate that satellite operators will continue to be able to place gateway earth stations in the band. Under those circumstances, we believe the existence of FSS earth stations should not preclude our consideration of this band for mobile use.

**b. 38.6-40 GHz Band**

35. *Background.* The band is licensed by Economic Area (EAs).<sup>84</sup> There are 176 EAs.<sup>85</sup> There are fourteen paired blocks of 50 by 50 megahertz channels.<sup>86</sup> The populations in areas covered by active licenses (both EA and Rectangular Service Area (RSA) licenses) vary by channel, but in aggregate they cover about 49 percent of the U.S. population. Out of 2,464 possible EA licenses (14 channel pairs for each of 176 EAs), 859 are currently licensed. Other licenses previously issued were voluntarily cancelled or terminated for failure to meet substantial service requirements.<sup>87</sup> In addition, there are currently 229 active RSA licenses that predate the creation of the EA licenses and where the licensees self-defined their service area. Those RSA licensees retain the exclusive right to operate within their RSAs.<sup>88</sup>

36. This band has a co-primary allocation for Fixed and Mobile services.<sup>89</sup> The Commission provided licensees the flexibility to provide mobile services and stated the belief that “the issue of technical compatibility of fixed and mobile operations within a service area is one that can and should be resolved by the licensee.”<sup>90</sup> The Commission declined to permit mobile operations, however, until it conducted a separate proceeding to resolve inter-licensee and inter-service interference issues.<sup>91</sup>

37. There are no Federal allocations in the 38.6-39.5 GHz band.<sup>92</sup> There is an adjacent Federal allocation for FSS (space-to-Earth) and Mobile Satellite Service (MSS) (space-to-Earth) in the 39.5-40 GHz band. Federal government earth stations in the MSS in the 39.5-40 GHz band are prohibited from claiming protection from non-Federal stations in the fixed and mobile services in this band, but are not required to protect non-Federal fixed and mobile services in the band (i.e., 5.43A of the ITU Radio regulations does not apply).<sup>93</sup> This prohibition does not apply to Federal government earth stations in the FSS. When the *39 GHz Order* was adopted, Federal government use of the band was limited to military systems in the 39.5-40 GHz band segment, but the Department of Defense stated that it had plans to

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<sup>83</sup> See *infra* ¶¶ 132-135.

<sup>84</sup> See 47 C.F.R. § 101.147(v)(2).

<sup>85</sup> Economic Areas are geographic areas established by the Bureau of Economic Analysis of the Department of Commerce and used by the Commission to define the coverage of spectrum licenses for certain services. There are 172 EAs, plus 4 EA-like areas, which have been assigned Commission-created EA numbers: 173 (Guam and the Northern Mariana Islands), 174 (Puerto Rico and the United States Virgin Islands), 175 (American Samoa), and 176 (the Gulf of Mexico). See 47 C.F.R. § 27.6(a).

<sup>86</sup> See 47 C.F.R. § 101.147(v)(1).

<sup>87</sup> See 47 C.F.R. § 101.17.

<sup>88</sup> See Amendment of the Commission’s Rules Regarding the 37.0-38.6 GHz and 38.6-40.0 GHz Bands, ET Docket No. 95-183, *Report and Order and Second Notice of Proposed Rule Making*, 12 FCC Rcd 18600, 18637 ¶ 79 (1997) (*39 GHz R&O*).

<sup>89</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>90</sup> See *39 GHz R&O*, 12 FCC Rcd at 18615 ¶ 24.

<sup>91</sup> See *39 GHz R&O*, 12 FCC Rcd at 18615 ¶ 25.

<sup>92</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>93</sup> See Table of Frequency Allocations, 47 C.F.R. § 2.106 n.US382.

implement satellite downlinks at 39.5-40 GHz in the future, and the National Aeronautics and Space Administration (NASA) identified 39.5-40 GHz as a possible space research band to accommodate future Earth-to-space wideband data requirements.<sup>94</sup> The *39 GHz Report and Order* expressed optimism that such plans would not affect the continued development of the 39 GHz band for non-government use, but the Commission said that it intended to address those interference issues in a future, separate proceeding that would focus on developing inter-licensee and inter-service standards and criteria.<sup>95</sup> At present, the U.S. Table of Frequency Allocations provides that Federal satellite services in the 39.5-40 GHz band are limited to military systems.<sup>96</sup>

38. Non-Federal government FSS (space-to-Earth) is co-primary throughout the entire 39 GHz band,<sup>97</sup> but under a “soft segmentation” band plan adopted by the Commission in 2003, FSS is subject to lower power flux density limits in the 37.5-40 GHz band to accommodate high-density fixed terrestrial systems.<sup>98</sup> Those power limits act to favor implementation of fixed systems over FSS systems. There are currently no non-Federal FSS authorizations or pending applications in this band.<sup>99</sup>

39. Akbar Sayeed, FiberTower, Motorola Mobility, Nokia, NYU Wireless, Qualcomm, Samsung, Straight Path, and XO support allowing mobile use in the 39 GHz band.<sup>100</sup> Samsung stated that “the 39 GHz spectrum shares the characteristics that Samsung values in potential millimeter wave spectrum.”<sup>101</sup> Straight Path and FiberTower, which are the largest incumbent licensees in the 39 GHz band, both support use of the band “for all potential applications, including mobile, fixed broadband, and backhaul services.”<sup>102</sup>

40. EchoStar, Inmarsat, SIA, and ViaSat argue that the Commission should take into account their interest in using both the 39 GHz band and the 37.5-38.6 GHz band for satellite broadband services

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<sup>94</sup> *39 GHz R&O*, 12 FCC Rcd at 18615 ¶ 25.

<sup>95</sup> *39 GHz R&O*, 12 FCC Rcd at 18615 ¶ 25.

<sup>96</sup> 47 C.F.R. § 2.106, Table of Frequency Allocations, Federal Government n.G117.

<sup>97</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>98</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106; Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations, IB Docket No. 97-95, *Second Report and Order*, 18 FCC Rcd 25428, 25438 ¶ 24 (2003) (“*V-Band Second Report and Order*”). See also 47 C.F.R. § 25.208(r). The Commission has pending a proposal to establish procedures pursuant to which FSS licensees may raise their power flux density levels if necessary to compensate for “rain fade.” See Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations, *Third Further Notice of Proposed Rulemaking*, 25 FCC Rcd 15663 (2010) (“*V-Band Third FNPRM*”).

<sup>99</sup> Hughes Network Systems, LLC, license file SAT-LOA-20111223-00248. See Policy Branch Information Actions Taken, Report No. SAT-00889, *Public Notice*, 27 FCC Rcd 9293 (IB Pol. 2012).

<sup>100</sup> Akbar Sayeed Comments at 9; FiberTower Comments at 16; Motorola Mobility Comments at 7; Nokia Comments at 25-26; NYU Wireless Comments at 34; Qualcomm Comments at 16-17; Samsung Comments at 43-44; Samsung Aug. 28 *Ex Parte* at 2; Straight Path Comments at 16-17; XO Comments at 3. Ericsson describes the 39 GHz band as a possible candidate for mobile use, although it prefers spectrum below 30 GHz. Ericsson Comments at 13-14, 38.

<sup>101</sup> Samsung Comments at 43.

<sup>102</sup> Straight Path Comments at ii. See also FiberTower Comments at 14-15.

as demand for those services increases.<sup>103</sup> EchoStar argues that there is long lead time involved in planning and constructing satellite systems and that it would be disruptive of that process to consider mobile use of the band.<sup>104</sup> EchoStar believes that mobile use is incompatible with satellite downlink operation.<sup>105</sup> O3b asks the Commission to consider the open *V-Band Third FNPRM* in parallel with this proceeding.<sup>106</sup> In contrast, Straight Path argues that the Commission should delete the FSS allocation from this band and terminate action on the *V-Band Third FNPRM* because it believes FSS use of the band would be inconsistent with terrestrial use.<sup>107</sup> Straight Path also requested a freeze on V-Band satellite licensing pending resolution of this proceeding.<sup>108</sup>

41. Bluwan S.A. believes that the 39 GHz band is best suited for non-mobile uses, such as backhaul or fixed wireless access.<sup>109</sup> Vivint Wireless, a fixed wireless broadband provider that relies on the 39 GHz band for backhaul, argues that mobile operating rights should be secondary to existing fixed operations in order to protect existing fixed operations.<sup>110</sup> It asks the Commission to avoid awarding mobile operating rights separately from the existing fixed rights.<sup>111</sup>

42. *Discussion.* We propose to authorize mobile operation in the 39 GHz band. The availability of up to 1.4 gigahertz of spectrum could support ultra-high data rates. Equipment manufacturers and licensees agree that the band is suitable for mobile use, and no commenter identified any reason why this band would be technically unsuitable for mobile use. Furthermore, this band has a worldwide mobile allocation. We seek detailed comment and analysis on the compatibility of mobile use with current and future Federal operations, including any technical rules necessary to ensure coexistence between Federal and non-Federal operations in this band.

43. We believe mobile use would be consistent with existing fixed uses in this band. Indeed, Straight Path, FiberTower, and XO, which are 39 GHz licensees, support authorizing mobile use in this band. As we will discuss in further detail below, we propose to grant existing 39 GHz licensees mobile rights and to issue new licenses containing both fixed and mobile operating rights. We believe this action will alleviate Vivint Wireless' concerns about compatibility between fixed and mobile uses because a single licensee will be able to coordinate fixed and mobile operations while avoiding interference.

44. The concerns raised by certain satellite operators do not provide a valid basis for rejecting the possibility of mobile service in the 39 GHz band. Unlike in 28 GHz, there are no current commercial satellite operations in the 39 GHz band, but there are federal operations. Furthermore, while several commenters express interest in using V-band to provide satellite service, no commenter expresses any concrete intention to provide such service. While commenters are correct that providing satellite service requires substantial lead time and investment, the same appears to be true of mobile service in the mmW bands. Declining to consider mobile use in this band because of possible future satellite use would be inconsistent with our duty to make available "[n]ationwide, and world-wide . . . radio communication

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<sup>103</sup> EchoStar Comments at 25-26, Inmarsat Comments at 5-6, O3b Comments at 11-12, SIA Comments at 9-10, ViaSat Comments at 11.

<sup>104</sup> EchoStar Comments at 25-26.

<sup>105</sup> EchoStar Comments at 25.

<sup>106</sup> O3b Comments at 12.

<sup>107</sup> Straight Path Comments at 19-21.

<sup>108</sup> See Letter from Russell H. Fox, Esq. and Angela Y. Kung, Esq., Counsel for Straight Path Communications, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission, IB Docket No. 97-95 and GN Docket No. 14-177 (filed Jan. 15, 2015).

<sup>109</sup> Bluwan S.A. Comments at 8-10.

<sup>110</sup> Vivint Wireless Comments at 2-4.

<sup>111</sup> Vivint Wireless Comments at 4.

service.”<sup>112</sup> Our intent is not to favor mobile service over fixed or satellite service. Instead, our goal is to develop a flexible regulatory framework that will accommodate the widest possible variety of compatible services and will allow the market to determine the best possible uses of the mmW bands. As with 28 GHz, we are seeking comment on proposals that could provide further opportunities for satellite use of the band through market-based mechanisms in a way that would be compatible with fixed and mobile service.

45. We deny Straight Path’s request that we consider deleting the satellite allocation in this band. We can readily envision that the mmW bands will be used for a variety of both satellite and terrestrial services. It appears that terrestrial mobile use of the mmW bands may initially be concentrated in large urban areas. Foreclosing use of the 39 GHz band for satellite could result in underutilization of the band. Furthermore, as we will discuss in more detail below, we propose a market-based mechanism that could facilitate mobile and satellite sharing.

46. We recognize that the 39.5-40 GHz portion of the band is allocated for Federal military satellite systems. Commenters that address this issue believe that mobile use would be compatible with those systems.<sup>113</sup> We seek comment below on whether any limitations or special rules on mobile use would be necessary in order to protect Federal military FSS use of the 39.5-40 GHz band. We also seek comment on the technical characteristics for the mobile applications envisioned for the band in order to enable federal agencies to conduct the necessary compatibility analysis.

### c. 37-38.6 GHz Band

47. *Background.* The Commission has not adopted terrestrial service rules for non-Federal operations in this band. In 2004, the Commission sought comment on establishing fixed and point-to-point multipoint service rules in the 37 GHz and 42 GHz bands, as well as allowing “mobile use in the future, if and when the technology develops.”<sup>114</sup> In early 2005, commenters, including First Avenue Networks, Inc., Winstar Communications, LLC, and the Fixed Wireless Communications Coalition (FWCC), believed that it was not in the public interest to license the 37 GHz and 42 GHz bands at that time because the supply of mmW wave spectrum exceeded the demand for such spectrum.<sup>115</sup> There are co-primary allocations for terrestrial mobile service in these bands, but the Commission has not yet adopted service rules to authorize such services.<sup>116</sup>

48. In 2004, the National Telecommunications and Information Administration (NTIA) sent a letter to the Commission identifying the following NASA receiving earth stations in the Space Research Service (SRS) in the 37-38 GHz band: Goldstone, California; Guam, Pacific Ocean; Merritt Island, Florida; Wallops Island, Virginia; and White Sands, New Mexico.<sup>117</sup> NTIA has subsequently identified

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<sup>112</sup> 47 U.S.C. § 151.

<sup>113</sup> See, e.g., Straight Path Comments at 21.

<sup>114</sup> See Amendment of the Commission's Rules Regarding the 37.0-38.6 GHz and 38.6-40.0 GHz Bands; Implementation of Section 309(j) of the Communications Act – Competitive Bidding, 37.0-38.6 GHz and 38.6-40.0 GHz Bands, ET Docket No. 95-183 and PP Docket No. 93-253, *Third Notice of Proposed Rulemaking*, 19 FCC Rcd 8232, 8242 ¶ 25 (2004) (“37/42 GHz Third NPRM”).

<sup>115</sup> See Reply Comments of the Fixed Wireless Communications Coalition, ET Docket No. 95-183 and PP Docket No. 93-253 (filed Jan. 3, 2005); Reply Comments of Winstar Communications LLC, ET Docket No. 95-183 and PP Docket No. 93-253 (filed Jan. 3, 2005); Comments of First Avenue Networks, Inc., ET Docket No. 95-183 and PP Docket No. 93-253 (filed Dec. 2, 2004).

<sup>116</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>117</sup> See Letter from Fredrick R. Wentland, Associate Administrator, Office of Spectrum Management, NTIA, dated March 24, 2004, to Mr. Edmond J. Thomas, Chief, Office of Engineering and Technology, FCC.

the NASA receiving earth station at Blossom Point, Maryland.<sup>118</sup> NTIA also identified Green Bank, Virginia; and Socorro, New Mexico National Science Foundation (NSF), which NSF cites as supporting their Very Long Baseline Interferometry (VLBI) earth station operations. NTIA noted the importance of the band 37-38 GHz to support U.S. goals to provide a permanent manned presence in earth orbit (on or near the moon) and to initiate manned exploration of the planet Mars, and to support VLBI by satellite. There is also a co-primary allocation for Federal space research, fixed, and mobile service operations in the 37-38.6 GHz band. NTIA identified 14 military sites in the 37-38.6 GHz band that required protection. In the 2004 letter NTIA recommended that coordination with the Federal operations be performed within the Interdepartment Radio Advisory Committee (IRAC) process. In 2006, NTIA sent a follow-up letter to the FCC reaffirming the need to protect NASA, NSF, and military operations from non-Federal terrestrial and FSS operations in the 37-38 GHz band.<sup>119</sup> NTIA requested that the protection of Federal operations be accomplished by establishing a footnote to the U.S. table of Frequency Allocations specifying the Federal sites and the coordination areas. NTIA also recommended that because of the potential for interference from airborne systems, the aeronautical mobile service allocation should be deleted from the 37-38 GHz band. In the *NOI*, we terminated action on the 2004 proceeding and stated we would resume consideration of potential uses of the 37 GHz band in this proceeding.<sup>120</sup>

49. In addition to Fixed and Mobile allocations, there is a co-primary non-Federal FSS (space-to-Earth) allocation.<sup>121</sup> As described above, the soft segmentation plan adopted in the *V-Band Second Report and Order* favors terrestrial services in the 37 GHz band.<sup>122</sup> Akbar Sayeed, Motorola Mobility, Nokia, Qualcomm, and Samsung support considering mobile use of this band.<sup>123</sup> Straight Path believes that this band may be appropriate for examining novel sharing techniques.<sup>124</sup>

50. As with the 39 GHz band, EchoStar, Inmarsat, SIA, and ViaSat oppose mobile use of this band, or ask the Commission to take into account their interest in using this band for satellite broadband services as demand for those services increases.<sup>125</sup>

51. *Discussion.* We propose to develop service rules for mobile operation in the 37 GHz band. The band consists of 1.6 GHz of contiguous spectrum that could potentially support high data-rate transmissions. Furthermore, it is contiguous to the 39 GHz band, so there could be opportunities to aggregate up to 3 gigahertz of spectrum. The 37 GHz band also has a worldwide co-primary mobile allocation.

52. As with the 39 GHz band, we do not believe the concerns of the satellite operators should preclude consideration of mobile use of this band. There are no non-Federal incumbent satellite operations in this band and no concrete announced plans to use this band for satellite use. Our intent is to establish a flexible rules framework that enables as wide a range of services as possible. Our proposals

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<sup>118</sup> See Letter from Karl B. Nebbia, Associate Administrator, Office of Spectrum Management, to Julius Knapp, Chief, Office of Engineering and Technology, *Re: Notification of Pending Status of Tracking and Data Relay Satellite System (TDRSS) Earth Station* (Mar. 20, 2014).

<sup>119</sup> See Letter from Fredrick R. Wentland, Associate Administrator, Office of Spectrum Management, NTIA, dated Sept. 13, 2006, to Mr. Julius Knapp, Chief, Office of Engineering and Technology, FCC.

<sup>120</sup> See *NOI*, 29 FCC Rcd at 13040-13041 ¶ 68.

<sup>121</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>122</sup> See *V-Band Second Report & Order*, 18 FCC Rcd at 25438 ¶¶ 23-24.

<sup>123</sup> Akbar Sayeed Comments at 9, Motorola Mobility Comments at 7, Nokia Comments at 25-26, Qualcomm Comments at 16-17, Samsung Aug. 28 *Ex Parte* at 2.

<sup>124</sup> Straight Path Comments at 27.

<sup>125</sup> EchoStar Comments at 25-26, Inmarsat Comments at 5-6, O3b Comments at 11-12, SIA Comments at 9-10, ViaSat Comments at 11. See also ¶ 40, *supra*.

and questions concerning facilitating satellite use—through a market-based mechanism—that is compatible with terrestrial use will include the 37 GHz band.

53. We recognize that this band is a shared Federal-non-Federal band. We will work together with NTIA to ensure that Federal operations are protected while maximizing the use of the 37 GHz band for commercial operations. In particular, we recognize that we will need to work with NTIA to develop appropriate protections for SRS facilities in the 37-38 GHz band. Another issue we will need to address is ensuring protection of Earth Exploration Satellite Service (EESS) passive observations below 37 GHz. We seek comment on these issues below.

**d. 64-71 GHz Band**

54. *Background.* There are no authorized non-Federal operations in this band. Unlicensed operations within the adjacent 57-64 GHz band are permitted under Part 15 of our rules.<sup>126</sup> Non-Federal government operators of outdoor radio equipment in the 57-64 GHz band segment are not required to obtain individual licenses or seek coordination with the NTIA if they limit average EIRP to 82 dBm minus 2 dB for every dB that their antenna gain is less than 51 dBi.<sup>127</sup> In 2013, the Commission expanded the use of Part 15 devices in the 57-64 GHz band in order to “help the Commission fulfill its objectives to bring broadband access to every American by providing additional competition in the broadband market, lowering costs for small business owners accessing broadband services, and supporting the deployment of 4<sup>th</sup> generation (4G) and other wireless services in densely populated areas.”<sup>128</sup> Specifically, the Commission allowed longer communication distances for outdoor point-to-point systems in the 57-64 GHz band by allowing higher powers, specified emission limits as an EIRP power level to provide uniformity and consistency in the rules, and eliminated the requirement for certain devices in the 57-64 GHz band to transmit identification information.<sup>129</sup> Frequencies from 64-71 GHz are not among those listed in our rules as available for licenses issued in the terrestrial Fixed Service<sup>130</sup> or for any satellite services except for Inter-Satellite service (ISS).<sup>131</sup> Our rules list 65-71 GHz as available for ISS licenses,<sup>132</sup> but there are no current ISS licenses.<sup>133</sup>

55. The 64-71 GHz band has a co-primary mobile allocation.<sup>134</sup> In the 64-66 GHz band, aeronautical mobile operation is prohibited.<sup>135</sup> The 65-71 GHz band is authorized for ISS links.<sup>136</sup> There are currently no active satellite licenses in that band. There are also a series of co-primary allocations for Federal and non-Federal Fixed, Radiolocation, Radionavigation-Satellite, EESS, and ISS operations throughout these bands.<sup>137</sup> International and domestic rules also indicate that any use of the 66-71 GHz

<sup>126</sup> See 47 C.F.R. §§ 15.15 and 15.255.

<sup>127</sup> 47 C.F.R. § 15.255(b)(1)(ii).

<sup>128</sup> Revision of Part 15 of the Commission’s Rules Regarding Operation in the 57-64 GHz Band, ET Docket No. 07-113, *Report and Order*, 28 FCC Rcd 12517 ¶ 1 (2013) (*60 GHz Report and Order*).

<sup>129</sup> *Id.*

<sup>130</sup> See 47 C.F.R. § 101.101.

<sup>131</sup> See 47 C.F.R. § 25.202(a)(1) and (5). The inter-satellite service (ISS) provides links between any satellite and other space stations. See 47 C.F.R. § 25.279.

<sup>132</sup> See 47 C.F.R. §§ 25.202(a)(5).

<sup>133</sup> The Commission’s IBFS database indicates that four inter-satellite service licenses or authorizations in the 65-71 GHz band have been revoked, and 15 such authorizations have been surrendered.

<sup>134</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>135</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>136</sup> See 47 C.F.R. § 25.202(a)(5).

<sup>137</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

band by the land mobile service is subject to not causing interference to, and accepting interference from, the space radiocommunication services in this band.<sup>138</sup>

56. Ericsson, IEEE 802, InterDigital, Qualcomm, SiBeam, and Wi-Fi Alliance support authorizing operations in the 64-71 GHz band under Part 15 of the Commission's rules.<sup>139</sup> Samsung believes that this band could be used in connection with the adjacent 57-64 GHz band to increase flexibility for users, lower the potential for interference, and support higher data rates for a number of applications, including wireless backhaul.<sup>140</sup> Samsung supports licensing the 64-71 GHz band and provides a recommended band plan.<sup>141</sup> SiBeam believes authorizing use of the 64-71 GHz band could facilitate "multigigabit, large scale, dynamically switches wireless network equivalent to current fiber metro networks."<sup>142</sup> Interdigital believes there will be no interference to any future ISS licensees because the primary network architecture will be a low height above ground terrestrial network for both small cells and backhaul.<sup>143</sup>

57. SIA noted the allocation for ISS links and "urge the Commission to preserve flexibility for future satellite access."<sup>144</sup> Nokia supports authorizing operations in the 64-71 GHz band on a licensed, geographic area basis because there are no current licensed operations in that band.<sup>145</sup>

58. *Discussion.* We note Nokia's preference for geographic area licensing and Samsung's interest in licensing the 64-71 GHz band, but tentatively conclude that authorizing operation under Part 15 of the Commission's rules is the better approach in this band. As discussed elsewhere, we propose geographic area licensing in other bands.<sup>146</sup> We believe that a balanced approach utilizing licensed, unlicensed, and hybrid mechanisms for authorizing service in the mmW bands will best accommodate a wide variety of services, providing multiple opportunities to put the spectrum to use, and encourage the development of different technologies and business models in these bands. We agree with commenters that authorizing Part 15 operations in the 64-71 GHz band will allow this band to be used in conjunction with the existing 57-64 GHz band to double the spectrum available for the next generation of unlicensed wireless broadband technologies such as ultra-high-speed audiovisual content streaming and WiGig connectivity that will offer low latency and security-protected connectivity between devices.<sup>147</sup> This will help meet the demand for access for unlicensed spectrum for lower-power end-user applications that continues to grow along with the demand for licensed radio spectrum for greater-distance, higher-power operations.

59. We believe authorizing Part 15 operation would be compatible with the allocation for ISS. Because of the high atmospheric absorption in this frequency range, it is highly unlikely that signals at the power levels contemplated would be able to reach satellites using ISS links. Are the technical considerations in the 57-64 GHz band fully applicable to deployment of unlicensed use in the 64-71 GHz

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<sup>138</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106 n.5.553.

<sup>139</sup> Ericsson Comments at 39; IEEE 802 Comments at 3; InterDigital Comments at 4, 19-21; Qualcomm Comments at 17-18; SiBeam Comments at 3-5; Wi-Fi Alliance Comments at 4-6. T-Mobile generally supports making spectrum over 60 GHz available for unlicensed use or dynamic access. T-Mobile Comments at 7-8.

<sup>140</sup> Samsung Comments at 46.

<sup>141</sup> See Samsung Aug. 28 *Ex Parte* at 2-3.

<sup>142</sup> SiBeam Comments at 3.

<sup>143</sup> InterDigital Comments at 21.

<sup>144</sup> SIA Comments at 9.

<sup>145</sup> Nokia Comments at 38.

<sup>146</sup> See Section IV.B.1. *supra*.

<sup>147</sup> Qualcomm Comments at 17, Wi-Fi Alliance Comments at 4.

band recognizing that unlicensed devices must protect allocated services including future systems? What additional technical and operational characteristics as well as interference mitigation techniques of the anticipated unlicensed use for this band need to be considered in assessing sharing with in-band and adjacent band incumbent services?

### 3. Other Bands

60. In this section, we discuss bands raised by commenters where we are not proposing service rules at this time. As noted below, with respect to certain of these bands, we seek comment on our analysis of these bands and ask interested parties to provide additional information concerning possible mobile uses of these bands. As we develop a further record in this proceeding, as technology develops, and as we develop a further record on compatibility issues with other allocated Federal and non-Federal services, we reserve the right to give further consideration to some of these bands. Given the early stage of the development of technologies for mobile mmW band, and the complex sharing issues raised in these bands, we believe the best approach is to initially focus our efforts on the strongest candidate bands, discussed above, which we believe are better positioned for more immediate use in the marketplace.

#### a. 24 GHz Bands (24.25-24.45 GHz and 25.05-25.25 GHz)

61. *Background.* There are two types of fixed licenses in this band. The 24 GHz Service has a total of 176 EA or EA-like service areas.<sup>148</sup> In 2004, the Commission held Auction 56, in which it made 890 24 GHz licenses available. Only seven of the 890 licenses were sold.<sup>149</sup> In addition, FiberTower and Puerto Rico Telephone Company hold a total of 49 pre-auction Digital Electronic Messaging Service licenses in this band.

62. The 25.05-25.25 GHz band segment has co-primary allocations for non-Federal government Fixed Service and FSS (Earth-to-space) services, and a footnote to the U.S. Table of Frequency Allocations provides that the use of the 25.05-25.25 GHz band by the FSS (Earth-to-space) is limited to feeder links for the Broadcast Satellite Service (BSS).<sup>150</sup> Section 25.203(l) of the Commission's rules provides that applicants for feeder link earth station facilities operating in the 25.05-25.25 GHz band may be licensed only in EAs where no existing Fixed Service licensee has been authorized, and shall coordinate their operations with 24 GHz Fixed Service operations if the power flux density of their transmitted signal at the boundary of the Fixed Service license area is equal to or greater than  $-114$  dBW/m<sup>2</sup> in any 1 MHz.<sup>151</sup> The *17/24 GHz Broadcasting-Satellite Service Report and Order* determined that future Fixed Service systems locating near an authorized 17/24 GHz BSS feeder link earth station may not claim protection from interference from the feeder link earth station's transmissions, provided that those transmissions are compliant with the Commission's rules, and that future 24 GHz Fixed Service applicants would be required to take into account the transmissions from the previously authorized earth station when considering system designs, including their choices of locations for their license areas.<sup>152</sup> There are three active licenses for feeder link earth stations in the 25.05-25.25 GHz band segment, all of them held by DIRECTV.<sup>153</sup>

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<sup>148</sup> See 47 C.F.R. § 101.5233.

<sup>149</sup> See 24 GHz Service Spectrum Auction Closes, Winning Bidders Announced, *Public Notice*, 19 FCC Rcd 14738 (WTB 2004).

<sup>150</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106, note NG 167. Pursuant to 47 C.F.R. § 25.202(g), 17/24 GHz BSS satellite telemetry, tracking, and command functions may also be authorized at the upper edge of the 25.05-25.25 GHz band.

<sup>151</sup> 47 C.F.R. § 25.203(l).

<sup>152</sup> Establishment of Policies and Service Rules for the Broadcasting-Satellite Service at the 17.3-17.7 Frequency Band and at the 17.7-17.8 GHz Frequency Band Internationally, and at the 24.75-25.25 GHz Frequency Band for Fixed-Satellite Services Providing Feeder Links to the Broadcasting-Satellite Service, *Report and Order and*

(continued....)

63. There is no mobile allocation in either of the 24 GHz band segments.<sup>154</sup> In the *24 GHz Report & Order*, the Commission found that it would be premature to allow mobile operations in the 24 GHz bands but reserved the discretion to revisit that issue if it is presented with technical information demonstrating that such operations would be technically feasible without generating interference to fixed operations and BSS feeder links in 24 GHz band segments.<sup>155</sup>

64. FiberTower and Nokia support authorizing mobile use in the 24 GHz bands.<sup>156</sup> Ericsson states that the 24 GHz bands may be suitable for backhaul use if sufficient spectrum can be aggregated.<sup>157</sup> The FSS Operators ask for FSS access to 25.05-25.25 GHz.<sup>158</sup>

65. *Discussion.* Commenters expressed a lower level of interest in the 24 GHz band than in other bands. We note that this band presents several challenges with respect to possible mobile use. Significantly, the amount of contiguous spectrum (two 200 megahertz blocks) available in these bands is less than many commenters currently recommend as the minimum amount of spectrum available for mobile use. This band also lacks an international mobile allocation; although we recognize that this could change in the future. We note that BSS feeder links in the upper part of the band are entitled to interference protection, and while not necessarily an insurmountable problem this would likely require complex analyses of the potential for aggregate interference from terrestrial wireless systems.

66. We do not wish, however, to preclude consideration of this band. We invite parties who are interested in mobile use of the 24 GHz band to comment on our analysis. Are there circumstances under which this band could be successfully used for the type of mobile systems, or other systems, contemplated for the mmW bands? Are there ways of allowing widespread deployments while protecting BSS feeder links? We ask commenters who support further consideration of this band to provide specific suggestions for addressing the issues we have identified above. Interested parties should also comment on the services that would likely be deployed in this band given the issues implicated and the possible viable business models. In those areas where there are incumbent fixed licenses, should we grant mobile rights to the incumbent fixed licensees? Would licensed or unlicensed rights be best for making this spectrum available and for facilitating coexistence? Are there rule changes that can be made to promote backhaul or other fixed uses?

**b. 29.1-29.25 GHz and 31-31.3 GHz**

67. *Background.* These bands are part of the LMDS. For the 29.1-29.25 GHz band segment, section 25.202 of the Commission's rules provides that 29.1-29.25 GHz is co-primary for MSS feeder links and LMDS,<sup>159</sup> and section 101.1001 of the Commission's rules limits LMDS to hub-to-subscriber transmissions in this band segment.<sup>160</sup> Section 25.257 of the Commission's rules allows as many as ten

(Continued from previous page) \_\_\_\_\_

*Further Notice of Proposed Rulemaking*, 22 FCC Rcd 8842, 8895 ¶ 128 (2007) ("*17/24 GHz Broadcasting-Satellite Service Report and Order*").

<sup>153</sup> See DIRECTV Enterprises, LLC, call signs E070027, E090173, and E130081.

<sup>154</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>155</sup> See Amendments to Parts 1, 2, 87 and 101 of the Commission's Rules to License Fixed Services at 24 GHz, WT Docket No. 99-327, *Report and Order*, 15 FCC Rcd 16934, 16938 ¶ 7 (2000).

<sup>156</sup> FiberTower Comments at 16, Nokia Comments at 28-29.

<sup>157</sup> Ericsson Comments at 40.

<sup>158</sup> FSS Operators Comments at 2-4.

<sup>159</sup> 47 C.F.R. § 25.202(a)(1) n.6. Pursuant to 47 C.F.R. § 25.202(g), the edges of the band are also used for telemetry, tracking, and command functions.

<sup>160</sup> 47 C.F.R. § 101.1001(b)(2).

MSS feeder link earth station complexes to be deployed in the 29.1-29.25 GHz band segment,<sup>161</sup> but there are currently only five active licenses for feeder link and telemetry, tracking, and command earth stations in those frequencies.<sup>162</sup> The 31-31.3 GHz band segment has co-primary allocations for terrestrial Fixed and Mobile services, with a secondary Federal and non-Federal allocation for space-to-Earth standard frequency and time signal operations.<sup>163</sup>

68. Iridium, which operates feeder links in the 29.1-29.25 GHz band, notes that its feeder links are co-primary and asks the Commission to “keep the Iridium system and the critical services it provides in mind even in the early stages of research into emerging terrestrial broadband technologies.”<sup>164</sup> While Straight Path generally favors making the LMDS band available for mobile use, it states that the presence of co-primary feeder links “may make mobile wireless use of the band more complicated and require further analysis.”<sup>165</sup> NCTA identifies the 29.1-29.25 GHz band as a band that may be suitable for unlicensed use and argues that unlicensed operation could facilitate sharing with incumbent users.<sup>166</sup>

69. We received little comment specifically directed to the 31-31.3 GHz band. Straight Path notes that Federal satellite uses in this band are secondary and do not require protection.<sup>167</sup> CORF notes that the 31-31.3 GHz band is immediately adjacent to a passive EESS sensing band in which all transmissions are prohibited, and it urges that the Commission protect EESS through guard bands.<sup>168</sup>

70. *Discussion.* We decline to propose authorizing mobile operation at this time, primarily because the bands offer considerably less than 500 megahertz of contiguous spectrum as commenters have suggested is necessary for mobile operations. Unlike in 27.5-28.35 GHz, the satellite facilities in 29.1-29.25 GHz have co-primary status. While it could be possible to develop a sharing regime between the feeder links and mobile operations, given the relatively small amount of spectrum at issue, we believe our efforts are better directed towards bands that offer more contiguous spectrum, such as 27.5-28.35 GHz. We also note that 31-31.3 GHz is shared between the A and B block licensees, so there may be instances where it may be difficult to aggregate even 300 megahertz of spectrum.

### c. 31.8-33 GHz

71. *Background.* There are international allocations for Fixed and Radionavigation services throughout this entire band, although administrations should take practical measures to minimize potential interference between those services, taking into account the operational needs of airborne radar systems.<sup>169</sup> The Radionavigation allocation is Federal throughout the entire band and non-Federal in the 32.3-33.4 GHz band.<sup>170</sup> In the United States, ground-based radionavigation aids are not permitted except when they operate in cooperation with airborne or shipborne radionavigation devices.<sup>171</sup> There is also a

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<sup>161</sup> 47 C.F.R. § 25.257(c). There is only one NGSO MSS operator (Iridium) licensed to use the 29.1-29.25 GHz band, but that operator may have up to eight feeder link earth station complexes transmitting in the band.

<sup>162</sup> On June 10, 2014, the Commission’s IBFS database listed five MSS Earth-to-space licenses for Iridium for the 29.1-29.25 GHz band, under call signs E960131, E960244, E960272, E050282, and E060300.

<sup>163</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>164</sup> Iridium Comments at 2.

<sup>165</sup> Straight Path Comments at 22.

<sup>166</sup> NCTA Comments at 5-6.

<sup>167</sup> Straight Path Comments at 22.

<sup>168</sup> CORF Comments at 6-7.

<sup>169</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106 n. 5.547A.

<sup>170</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106. See also 47 C.F.R. § 87.173(b).

<sup>171</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106 n. US69.

co-primary Space Research (deep space) (space-to-earth) allocation in the 31.8-32.3 GHz band, and an ISS allocation in the 32.3-33 GHz band.<sup>172</sup> In addition, this band is adjacent to the 31.3-31.8 GHz bands, where no transmissions are authorized in order to protect radio astronomy observations.<sup>173</sup>

72. Samsung supports adding this band to the Commission's consideration of mmW bands for mobile service in light of European and Asian regional support for consideration of this band.<sup>174</sup> ESOA generally supports examination of bands above 31 GHz.<sup>175</sup>

73. *Discussion.* This band presents particularly difficult challenges for mobile use. The need to protect the 31.3-31.8 GHz passive band, existing Federal systems, and deep-space research appears to severely limit the availability of useable spectrum in this band. Furthermore, there currently is no mobile allocation in this band, whereas there are existing mobile allocations for other bands under consideration.

74. In the interests of developing a complete record, we invite commenters who support further consideration of this band to comment on our analysis. In particular, we seek a detailed technical analysis of the out-of-band emission limits required to protect the 31.3-31.8 GHz band to help determine how much of this band could potentially be available for mobile use. We also seek comment on the compatibility of mobile use with the existing aeronautical and shipborne radar use of this band, future radionavigation and other federal services, as well as the deep space research in the 31.8-32.3 GHz band. Given the important incumbent uses of this band and the adjacent band, interested parties should comment on how sharing would work between mobile and existing incumbent uses.

#### **d. 42-42.5 GHz**

75. *Background.* There are currently no terrestrial service rules in place for this band. On May 9, 2012, FWCC filed a petition for rulemaking seeking the establishment of service rules for fixed point-to-point use of the 42-43.5 GHz band under Part 101 of the Commission's rules.<sup>176</sup> There are Federal and non-Federal co-primary allocations for terrestrial mobile service in different segments of these bands, but the Commission has not yet adopted service rules to authorize such services.<sup>177</sup> A footnote in the U.S. Table of Frequency Allocations urges all operations in the 42-42.5 GHz band to take all practicable steps to protect radio astronomy observations in the 42.5-43.5 GHz band from interference.<sup>178</sup>

76. In addition to Fixed and Mobile allocations, there are Broadcasting and BSS allocations in this band.<sup>179</sup> The Commission has proposed eliminating those BSS allocations and adding an FSS

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<sup>172</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>173</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106 n. US246.

<sup>174</sup> Samsung Aug. 28 *Ex Parte* at 2. Samsung proposes the 31.8-33.4 GHz band "due to the level of interest expressed in the regional preparation process for WRC-15." *Id.* CITEL recommends further study of the 31.8-33 GHz band. In light of the CITEL recommendation, we propose to limit our consideration to 31.8-33 GHz.

<sup>175</sup> ESOA Comments at 3-5.

<sup>176</sup> Petition for Rulemaking, Fixed Wireless Communications Coalition, RM-11664 (filed May 9, 2012). FWCC originally sought the establishment of service rules for the 41-42.5 GHz band. In light of opposition from satellite licensees, FWCC revised its proposal to specify the 42-43.5 GHz band. See Letter from Mitchell Lazarus, Esq., counsel for the Fixed Wireless Communications Coalition to Marlene H. Dortch, Secretary, Federal Communications Coalition, RM-11664 (filed Feb. 11, 2013).

<sup>177</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>178</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106 n.US211.

<sup>179</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

(space-to-Earth) allocation in order to protect adjacent channel radio astronomy in the 42.5-43.5 GHz band.<sup>180</sup>

77. Motorola Mobility, Nokia, Qualcomm, and Samsung include this band in the list of bands that should be examined for possible mobile use.<sup>181</sup> On the other hand, Ericsson describes this band as being of “no current interest” because it is only a single 500 megahertz block.<sup>182</sup>

78. CORF describes the adjacent 42.5-43.5 GHz band as being one of the most important bands for radio astronomy because it is used to observe silicon monoxide, which yields important information on stellar temperatures, density, and wind velocities.<sup>183</sup> Under our current rules, all practicable steps must be taken to protect the radio astronomy service from interference in the 42.5-43.5 GHz service.<sup>184</sup> FWCC contends that the 42-43.5 GHz band is more suitable for fixed point-to-point service.<sup>185</sup>

79. *Discussion.* While this band could possibly be used for mobile, it is not as desirable as the bands for which we are proposing service rules at this time. The band has 500 megahertz of contiguous spectrum, but the need to protect the adjacent radio astronomy band at 42.5-43.5 GHz may require limits on the use of the band. Interest in this band among commenters was somewhat lower than in bands where we are proposing rules authorizing mobile service. The band also is not part of the United States or CITELE proposals for bands to be considered for further study for mobile use. Finally, we note that there are competing proposals to make this band available for FSS or fixed use. While it may be possible to work through those issues, authorizing mobile service in this band would be more complicated than in bands such as 28 GHz and 39 GHz.

80. In light of the competing proposals for use of this band, we seek comment on the relative merits of using this band for FSS, fixed, or mobile use, or the ability to share among these different uses. What sort of services would be offered using this band? We also ask commenters to analyze how the need to protect radio astronomy in the 42.5-43.5 GHz band affects the viability of this band for the services they support. We also seek comment on the extent to which different services could share in this band, and what sharing mechanisms, if any, would be appropriate.

**e. 71-76 GHz and 81-86 GHz**

81. *Background.* In 2003, the Commission established service rules to promote non-Federal fixed development and use of spectrum in the 71-76 GHz, 81-86 GHz, and 92-95 GHz bands.<sup>186</sup> Based on its determination that systems in these bands can readily be engineered to produce highly directional, “pencil-beam” signals that can co-exist in the same vicinity without causing interference to one another, the Commission adopted a flexible and innovative regulatory framework for the bands.<sup>187</sup> Specifically, the framework permits the issuance of an unlimited number of non-exclusive, nationwide licenses to non-Federal government entities for all of these bands. Under this licensing scheme, a license serves as a

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<sup>180</sup> See *V-Band Third FNPRM*, 25 FCC Rcd at 15668-15670 ¶¶ 12-19.

<sup>181</sup> Motorola Mobility Comments at 7, Nokia Comments at 25-26, Qualcomm Comments at 16-17, Samsung Comments at 44.

<sup>182</sup> Ericsson Comments at 38-39.

<sup>183</sup> CORF Comments at 7-8.

<sup>184</sup> United States Table of Allocations, 47 C.F.R. § 2.106 n.US342.

<sup>185</sup> FWCC Comments at 3.

<sup>186</sup> See generally Allocations and Service Rules for the 71-76 GHz, 81-86 GHz, and 92-95 GHz Bands, WT Docket No. 02-146, *Report and Order*, 18 FCC Rcd 23318 (2003) (*70-80-90 GHz R&O*); 47 C.F.R. § 101.1523.

<sup>187</sup> See *70-80-90 GHz R&O*, 18 FCC Rcd at 23337-23339 ¶¶ 44-47.

prerequisite for registering individual point-to-point links; licensees may operate a link only after the link is registered with a third-party database.<sup>188</sup>

82. As of September 22, 2015, there were 408 active non-exclusive nationwide licenses covering the 70 GHz, 80 GHz, and 90 GHz bands.<sup>189</sup> Based upon information available from the third-party database managers that are responsible for registering links in those bands, as of September 22, 2015 there were approximately 12,687 registered fixed links in the 71-76 GHz and 81-86 GHz bands.<sup>190</sup>

83. Non-Federal operations may not cause harmful interference to, nor claim protection from, Federal Fixed-Satellite Service operations located at 28 military bases.<sup>191</sup> In addition, in the 80 GHz band, licensees proposing to register links located near 18 radio astronomy observatories must coordinate their proposed links with those observatories.<sup>192</sup> Third-party database managers are responsible for recording each proposed non-Federal link in the third-party database link system and coordinating with NTIA's automated "green light/yellow light" mechanism to determine the potential for harmful interference to Federal operations and radio observatories.<sup>193</sup>

84. The 71-74 GHz band segment also has co-primary allocations for Federal and non-Federal Fixed, FSS, Mobile, and MSS (space-to-Earth) operations.<sup>194</sup> The 74-76 GHz band segment has co-primary allocations for Federal and non-Federal government Fixed, FSS (space-to-Earth), Mobile, and SRS operations.<sup>195</sup> In addition, there are non-Federal allocations in that band segment for Broadcasting and BSS operations.<sup>196</sup> The 81-86 GHz band has co-primary allocations for Federal and non-Federal government Fixed, FSS (Earth-to-space), and Mobile, and within that band the 81-84 GHz band segment also has a Federal and non-Federal government allocation for MSS (Earth-to-space).<sup>197</sup> The 76-77 GHz band is currently used for unlicensed vehicular radars under Part 15 of the rules.<sup>198</sup> The Commission has

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<sup>188</sup> See *70-80-90 GHz R&O*, 18 FCC Rcd at 23340-23341 ¶¶ 50-51.

<sup>189</sup> These statistics are based on a review of the Universal Licensing System on September 22, 2015.

<sup>190</sup> These statistics are based on a review of the third party database managers' data on September 22, 2015. See [www.micronetcommunications.com/LinkRegistration/](http://www.micronetcommunications.com/LinkRegistration/); [www.comsearch.com/applications/link7090/index.jsp](http://www.comsearch.com/applications/link7090/index.jsp); <http://mmradioforms.com/mmRadioForms/FrontPage.aspx>

<sup>191</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106 n.US389.

<sup>192</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106 n.US388.

<sup>193</sup> See Wireless Telecommunications Bureau Announces Permanent Process for Registering Links in the 71-76 GHz, 81-86 GHz, and 92-95 GHz Bands, *Public Notice*, 20 FCC Rcd 2261 (WTB BD 2005). A "green light" response indicates that the link is successfully coordinated with the Federal government; a "yellow light" response indicates a potential for interference to Federal government or certain other operations. See generally 47 C.F.R. § 2.106 (US388, US389). In the case of a "yellow light," the licensee must file an application for the requested link with the Commission, which in turn will submit the application to the IRAC for individual coordination. See *70-80-90 GHz R&O*, 18 FCC Rcd at 23341-43 ¶¶ 52, 54, 58. This automated process is designed to streamline the administrative process for non-Federal users in the bands. We noted that the classified nature of some Federal government operations precludes the use of a public database containing both Federal government and non-Federal government links. See *70-80-90 GHz R&O*, 18 FCC Rcd at 23340 ¶ 48.

<sup>194</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>195</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>196</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>197</sup> See U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106.

<sup>198</sup> See 47 C.F.R. § 15.253.

proposed to authorize non-Federal radar applications in the 76-81 GHz band on a licensed basis under Part 95. This proposal would shift vehicular radars away from the existing Part 15 unlicensed model.<sup>199</sup>

85. Akbar Sayeed and Nokia identify these bands as appropriate candidates for mobile use.<sup>200</sup> Nokia believes these bands would be particularly appropriate because the wide amount of bandwidth available would support 10 Gbps peak rate with relatively simple equipment.<sup>201</sup> Ericsson argues that these bands might support mobile service “but would not be the industry’s primary choice.”<sup>202</sup> IEEE802, NCTA, and Wi-Fi Alliance ask that a Part 15 authorization be added to these bands.<sup>203</sup> FWCC and McKay Brothers highlight the existing uses of these bands for fixed backhaul and specialized telecommunications services, and urge that these existing services be protected.<sup>204</sup> FWCC, McKay Brothers, and SiBeam also note or propose changes to the existing fixed rules for 70 GHz and 80 GHz.<sup>205</sup>

86. *Discussion.* The interest among commenters in using this band for mobile operations is rather limited. Furthermore, the coordination process between fixed and mobile operations would be considerably more complicated in these bands because there are multiple fixed licensees in a given area (as opposed to 28 GHz or 39 GHz, where there is one licensee in a given area and band). The need to protect Federal earth stations and radio astronomy locations would also require limits on mobile operations in these bands.

87. We do not offer a specific proposal at this time to amend our rules relating to the 70 GHz and 80 GHz bands. Based on the current record, it is not clear how mobile units would be controlled to avoid interference to fixed links. None of the proponents of unlicensed use in these bands has made a detailed showing that unlicensed devices would be compatible with the fixed equipment being deployed in these bands. Furthermore, we are proposing to make seven gigahertz of additional spectrum available for unlicensed use in the 64-71 GHz band. We seek comment, however, on whether the Commission should revisit its 2003 decision not to allow Part 15 operations in these bands,<sup>206</sup> and if so, what specific bands we should consider for Part 15 operations (or for licensed use) and how such operations in those bands would be compatible with existing fixed operations, as well as Federal earth stations and radio astronomy operations. If we authorized sharing between fixed and mobile systems, what would the sharing mechanism look like and how should it be administered? What type of mechanisms would we need to establish to ensure there is no harmful interference?

88. With respect to the proposals to change the current Part 101 rules governing fixed operations in these bands, we believe these proposals are better addressed in our Wireless Backhaul proceeding, WT Docket No. 10-153. In that proceeding, we have under consideration a variety of proposed rule changes to our Part 101 Fixed Service rules. We note that FWCC originally filed its proposal for changes to the antenna standards in that proceeding.

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<sup>199</sup> See Amendment of Parts 1, 2, 15, 90 and 95 of the Commission’s Rules to Permit Radar Services in the 76-81 GHz Band, ET Docket No. 15-26, *Notice of Proposed Rulemaking and Reconsideration Order*, 30 FCC Rcd 1625, 1632-1638 ¶¶ 24-44 (2015).

<sup>200</sup> Akbar Sayeed Comments at 9, Nokia Comments at 34.

<sup>201</sup> See Nokia 5G Technology and Spectrum, *Ex Parte* (filed Aug. 26, 2015) at 4.

<sup>202</sup> Ericsson Comments at 39-40.

<sup>203</sup> IEEE802 Comments at 3-4, NCTA Comments at 5-6, Wi-Fi Alliance Comments at 6-8.

<sup>204</sup> FWCC Comments at 3-4, McKay Brothers Comments at 5-6.

<sup>205</sup> FWCC Comments at 4 (proposing changes to antenna standards to allow smaller antennas in 70 GHz and 80 GHz); McKay Brothers Comments at 6-7 (proposing allowing updating of registrations and requiring filing of construction notifications); SiBeam Comments at 6 (proposing changes to antenna standards to allow deployment of phased array antennas that could be dynamically reconfigured).

<sup>206</sup> See *70-80-90 GHz R&O*, 18 FCC Rcd at 23336 ¶ 41.

**f. Above 86 GHz**

89. *Background.* IEEE802, Marcus Spectrum, NYU Wireless, Wi-Fi Alliance, and Wireless Innovation Forum expressed support for consideration of some combination of bands above 86 GHz for use.<sup>207</sup> Marcus Spectrum pointed to a petition for rulemaking filed by Battelle Memorial Corporation seeking service rules for licensed use of the 102-109.5 GHz band.<sup>208</sup> NYU Wireless described the frequencies above 100 GHz as a “technical playground” that could lead to new technical innovations.<sup>209</sup> Marcus Spectrum urges that the presence of co-primary passive allocations should not preclude use of the frequencies above 95 GHz.<sup>210</sup>

90. In the 92-95 GHz band, unlicensed operation is allowed only for devices that are capable of operating only indoors.<sup>211</sup> In 2003, there was considerable interest in using the band more generally for unlicensed use, but the Commission declined to authorize outdoor or airborne use because of possible harmful interference to radio astronomy from unlicensed outdoor devices.<sup>212</sup>

91. *Discussion.* We are encouraged by commenters’ expressions of interest in frequencies above 86 GHz. At the same time, as Marcus Spectrum points out, there are a wide variety of combinations of allocations in the frequencies above 86 GHz. We believe the most appropriate means of proceeding is to consider proposals for use of specific frequency bands. The specific proposal we have before us is Battelle’s proposal to establish licensed service rules for the 102-109.5 GHz band. We will consider that proposal in the Wireless Backhaul proceeding, WT Docket No. 10-153. We invite other interested parties to submit other proposals, including proposals for authorizing use under our Part 15 rules. We also note that, unlike in 2003, there has been no advocacy for further unlicensed use in the 92-95 GHz band.

**B. Rules for Licensed Operations in the 28 GHz, 39 GHz, and 37 GHz Bands – Creation of the Upper Microwave Flexible Use Service**

92. In this section, we set forth our proposal for licensing rules for the 28 GHz, 39 GHz, and 37 GHz bands. These proposals are built off of the Commission’s significant experience crafting licensing rules that promote the widespread deployment of spectrum. These proposals strike a balance between more traditional geographic-area licensing and innovative licensing schemes aimed at meeting needs of different users for different uses. In the 28 GHz and 39 GHz band, we propose a traditional geographic area licensing scheme that is flexible to provide access and protection for fixed, mobile, and FSS uses. In the 37 GHz band, we propose a licensing model that attempts to maximize the use of spectrum by creating rights for both local area networks and wide area networks. We seek comment on these proposed licensing mechanisms, and alternatives.

**1. 28 GHz and 39 GHz Bands - Geographic Area Licensing**

93. We propose to create a new service for the 28 GHz and 39 GHz bands – the Upper Microwave Flexible Use Service – and propose to establish rules to allow an Upper Microwave Flexible

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<sup>207</sup> IEEE802 Comments at 3-4 (unlicensed use above 71 GHz); Marcus Spectrum Comments at 2-3 (above 95 GHz); NYU Wireless Comments at 29 (make 5 GHz of spectrum above 100 GHz available for unlicensed use); Wi-Fi Alliance Comments at 9 (above 95 GHz); Wireless Innovation Forum Comments at 6 (above 86 GHz for fixed backhaul).

<sup>208</sup> Marcus Spectrum Comments at 3-4. *See* Petition for Rulemaking, Battelle Memorial Institute, RM-11713 (filed Feb. 6, 2014).

<sup>209</sup> NYU Wireless Comments at 6.

<sup>210</sup> Marcus Spectrum Comments at 3-4.

<sup>211</sup> *See* 47 C.F.R. § 15.257.

<sup>212</sup> *70-80-90 GHz R&O*, 18 FCC Rcd at 23336 ¶ 40.

Use Service licensee to provide any form of fixed or mobile service (including aeronautical mobile, where consistent with the allocation). For current 28 GHz and 39 GHz licensees, we propose to grant new licenses that provide new flexible rights to operate in the licensed geographic area and include the same spectrum, with authorization for both fixed and mobile operations. For geographic license areas with no existing LMDS or 39 GHz licensees, we would assign these new Upper Microwave Flexible Use Service licenses via competitive bidding. Finally, as described in further detail below, we propose to allow FSS providers to acquire these licenses through auction or the secondary market, thereby allowing them to continue to operate or expand in these bands.

94. We believe there are several advantages to using a geographic area licensing approach in these bands. Issuing a single license including both fixed and mobile service rights would allow the licensee to coordinate fixed and mobile uses within its geographic area. Such an approach would be consistent with the Commission's prior decision to use geographic area licensing for fixed and point-to-multipoint service in these bands. In addition, geographic licensing is consistent with the Commission's licensing approach for flexible use bands, such as bands licensed under Part 27 of the Commission's rules.<sup>213</sup> We also note that a wide variety of commenters supported geographic area licensing in these bands.<sup>214</sup> We seek comment on this proposal.

95. We propose to permit existing LMDS and 39 GHz licensees to exercise the full extent of these rights – including mobile rights – for geographic areas and bands in which they currently hold licenses. There are several likely advantages to this proposal. First, this approach will minimize transaction costs and provide the fastest transition to expanded use of the band, which would be to the benefit of consumers. In these bands, we believe it is particularly important to take actions that will expedite service because of the great benefits these new technologies could bring to consumers and because of the technical and logistical challenges licensees will face. Second, traditional fixed operation in these bands consists of tightly focused beams between two points. With the development of massive MIMO antennas and other technologies, mobile operations also will consist of tightly focused beams between a base station and a mobile unit such as a handset. Given the technical characteristics of this band and the nature of the services that may be developed for it, the differences between fixed and mobile operation are increasingly blurred. Attempting to define separate bundles of “fixed” and “mobile” rights might create unnecessary complexity and be inconsistent with the underlying technologies, in which case it would be more efficient to have both the fixed and mobile usage rights contained within the same license. Third, and related to the difficulty in distinguishing between fixed and mobile services in this band, the existence of separate licenses for fixed and mobile operation might create unusually large challenges related to interference. One point-to-point link could preclude mobile use of the spectrum in a downtown region. A single license that combines both fixed and mobile rights avoids this issue and provides the licensee with the appropriate incentives to evaluate the tradeoffs between different uses.

96. Further, the Commission previously contemplated that LMDS and 39 GHz licensees would have the opportunity to engage in mobile operations if the associated technical issues could be resolved.<sup>215</sup> Such a policy also would be consistent with the Commission's decision to grant existing MDS and ITFS licensees blanket authority to engage in mobile operations when the Commission instituted geographic area licensing for those services in the 2.5 GHz band.<sup>216</sup> A variety of commenters

<sup>213</sup> See 47 C.F.R. § 27.6 (establishing geographic areas for licenses for Part 27 flexible use services).

<sup>214</sup> See CTIA Comments at 8-10, FiberTower Comments at 17-18, Nokia Comments at 31, Qualcomm Comments at 16-17, Samsung Comments at 39, Straight Path Comments at 22-24, T-Mobile Comments at 6-7, XO Comments at 3-6.

<sup>215</sup> See *LMDS Second Report & Order*, 12 FCC Rcd at 12637 ¶ 207; *39 GHz R&O*, 12 FCC Rcd at 18615 ¶ 24.

<sup>216</sup> See Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands, *Report and Order and Further Notice of Proposed Rulemaking*, WT Docket No. 03-66, 19 FCC Rcd 14165, 14210 ¶¶ 111-112 (2004).

support this approach.<sup>217</sup> We accordingly seek comment on the proposal to award mobile operating rights to existing LMDS and 39 GHz licensees, and the costs and benefits of so doing.

97. We recognize, however, that alternative approaches exist to assign flexible use rights in geographic areas and bands with existing LMDS and 39 GHz licensees. In particular, we seek comment on the costs and benefits of establishing an overlay right that would allow new licensees flexibility in use, subject to noninterference with the incumbent licensees. While our principal proposal is to directly assign flexible use rights to existing licensees in lieu of establishing an overlay right, we acknowledge certain benefits to assigning such rights using competitive bidding and seek comment on whether to award overlay rights for these bands through auction. First, an auction would assign these rights to the user that values the set of rights most highly, whether it be an incumbent licensee or a new potential user. Second, the use of an auction, rather than a direct grant of additional rights to existing licensees, ensures that a portion of the value associated with these additional rights will accrue to the United States Treasury. Third, the Commission has relevant experience in the application of overlay rights in other bands. In particular, the Commission established overlay rights in the 39 GHz band when it overlaid the Economic Area licenses on top of the existing RSA licenses.<sup>218</sup> The Commission has also combined overlay licensing with mechanisms to relocate incumbent users in the PCS, AWS-1, and AWS-3 bands.<sup>219</sup>

98. We invite commenters to address these and related other issues that will help us identify the most efficient means for assigning these new, flexible use rights consistent with our obligations under Section 309(j) of the Communications Act, especially in geographic areas and in spectrum that currently has incumbent licensees. We ask commenters to provide data on the costs and benefits associated with each approach.

## 2. 37 GHz – Hybrid Authorizations

99. As we noted in the *NOI*, “we aim to develop a framework that will accommodate as wide a variety of services and uses as possible.”<sup>220</sup> We also noted two primary models of wireless network deployments – service provider models, and decentralized Wi-Fi—like deployment deployed by end users.<sup>221</sup> Our proposed licensing model for the 28 GHz and 39 GHz bands will ensure that extensive spectrum is available for service provider deployments of 5G small cells or other fixed or mobile technologies that service providers may deem appropriate. Similarly, our proposal for 64-71 GHz would extend the existing 57-64 MHz band, making 14 gigahertz of contiguous spectrum available for short-range unlicensed uses

100. We propose to establish service rules for the 37 GHz band that would enable flexibility to facilitate a third type of network deployment: privately deployed networks that can provide 5G communications for advanced enterprise and industrial applications not suited to unlicensed spectrum or public network services. These applications might require licensed spectrum rights tailored to physical facility boundaries. The inherent short-range characteristics of millimeter wave spectrum make it well-suited to serve this need, and might also facilitate natural coexistence between a private, local area network, and a more traditional commercial wide area network. Unlike in the 28 GHz and 39 GHz bands, there are no incumbent non-Federal terrestrial authorizations in the 37 GHz band. This lack of incumbents gives us additional flexibility in designing a licensing mechanism for this band. We therefore seek comment on a hybrid licensing scheme that would convey licensed “local area” operating rights to

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<sup>217</sup> See EchoStar Comments at 22-25 (28 GHz band only), FiberTower Comments at 16, NYU Wireless Comments at 30, Straight Path Comments at 23, TMobile Comments at 7, XO Comments at 3-4.

<sup>218</sup> See *39 GHz R&O*, 12 FCC Rcd at 18637 ¶ 79.

<sup>219</sup> See 47 C.F.R. §§ 24.239-24.253 (rules for relocating incumbent microwave users from the PCS band), 27.1111, 27.1160-27.1190 (relocation rules and policies for AWS-1 and AWS-3 bands).

<sup>220</sup> *NOI*, 29 FCC Rcd at 13026 ¶ 15.

<sup>221</sup> *NOI*, 29 FCC Rcd at 13031 ¶¶ 36-37.

premises occupants by rule, and separately, geographic area licenses for wide area use. We also seek comment on variations on this proposal as discussed below. Because this mode of licensing would not exhaustively license all geography, we seek comment on ways to establish geographic area licenses for wide area use. We also seek comment on the proper regulatory relationship between the two categories of licenses.

101. We believe several facts support making 37 GHz band spectrum available for licensed local area networks. First, radio signals in this band propagate over short distances (due to atmospheric absorption) and signals are heavily attenuated by exterior walls and windows.<sup>222</sup> With those characteristics, it could be possible to separate local-area deployments from each other and also from wide-area deployments by simply leveraging the physical properties of the spectrum. Second, as a practical matter, local-area millimeter wave deployments will require permission of the property owner for siting, installation, backhaul, etc. Or alternatively, a property owner will need the permission of the licensee to use the spectrum within their own property, and the licensee may not have an incentive to bargain with the property owner even if the property owner has a strong need for the spectrum. Therefore, it may be highly efficient to convey the initial spectrum assignment for these environments directly to the owner or user of the local area rather than a third-party entity.

102. We propose that local area operating rights in the 37 GHz band be awarded by rule, pursuant to Section 307(e) of the Communications Act. We seek comment on how to define “local area” for these purposes. If we limit operations to indoor only, what applications would be precluded by limiting devices to indoor use only? What consideration should be given to the tradeoffs between these factors? Should the rule convey rights to property owners? If so, should the rights apply equally to private and public property? Should we explicitly exclude outdoor “public spaces” (e.g., streets, parks)? Should we allow those rights to be conveyed through standard instrumentalities of state law (e.g., as part of a standard property lease) or should we establish special rules governing conveyance of these operating rights? Alternatively, should the usage rights automatically attach to the current lawful occupant of a property (i.e., tenants)? Should the rights be conveyed only for indoor uses or should outdoor uses (e.g., courtyards, campus environments) also be authorized? Should the rule relate to the deployment of network facilities (e.g., a right to deploy base stations or access points in the local area) or more broadly to RF protections (e.g., a right to quietude in the local area)? Should the local area operating rights only apply to facilities exceeding some minimum size? How do we ensure that equipment is used in a manner consistent with any restrictions we place on local area operations?

103. We further propose that wide area rights in the 37 GHz band be defined as area licenses assigned through auction. Holders of these licenses would be entitled to deploy service in any and all areas not awarded through the rule-based licensing approach described above. For example, if we were to determine that the local area rights attach to indoor deployment of the 37 GHz band, the wide area rights would authorize outdoor deployment. We presume that those licenses would otherwise be similar in character to traditional geographic licenses. We seek comment on this proposal. We seek comment below on the appropriate license area size.

104. We seek comment on the RF coexistence of local area and wide area deployments, and how the coexistence should affect the definition of and relationship between the two classes of rights. Specifically, we seek technical comment on the propagation of this spectrum through typical building materials, and to what extent modern building materials used in energy-efficient construction affect attenuation outside of the building. We seek comment on whether, to distinguish the rights between the use cases and facilitate coexistence through licensing rights, one of the two categories of licensees should have the right to assert claims of harmful interference against the other? Or should it be presumed that any licensee operating within the rules will be on equal footing with any other and every user would have

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<sup>222</sup> See Theodore S. Rappaport, et al., *Millimeter Wave Mobile Communications for 5G Cellular: It Will Work!*, IEEE Access Vol. 1 (Apr. 8, 2013) at 340-341 (tinted glass and brick pillars have high penetration losses of 40.1 dB and 28.3 dB, respectively).

a duty to coordinate with its neighbors? Could relatively lower authorized power limits for local area users minimize the interference risks to wide area users? Conversely, could “self-help” remedies (e.g., RF shielding) protect local area users from higher power wide area network transmissions?

105. *Alternative Proposal.* As an alternative to the foregoing proposal, we could divide the 37 GHz Band into several blocks and assign some of these blocks by rule for local area uses (as described above). For example, the 1600 MHz bandwidth could be divided into three 533 megahertz or four 400 megahertz blocks. One or two of these blocks could be assigned by rule to local area uses and the others could be licensed on a geographical area basis and assigned through an auction process. A band-wide interoperability rule would ensure that equipment would be available for all users in the band. Dividing the band spectrally in this way may not be as efficient, from a local network standpoint, as dividing it geographically, as proposed above, because it may result in local area networks not being able to access the full frequency range in the band. On the other hand, it may be easier to implement procedurally and would eliminate any concerns about co-channel interference between local area and wide area networks sharing the same frequencies. We seek comment on this alternative proposal.

106. A second alternative would be to use geographic area licensing of all rights, but use geographic areas small enough to accommodate local area users without extensive partitioning of large licenses. This alternative will be discussed in further detail in the License Area Size section, *supra*.

### 3. License Area Size for the 28 GHz, 39 GHz, and 37 GHz Bands

107. In the *NOI*, after noting that 28 GHz had already been licensed by BTA and 39 GHz had already been licensed by EA, we sought comment on ways in which geographic area licensing could be tailored to ensure greater utilization of spectrum for mobile services in the millimeter wave bands, including by selecting the optimal geographic area size.<sup>223</sup> We also observed that, in determining the appropriate service area size, larger license sizes can make it difficult to generalize across different licenses in different areas, while smaller license sizes can raise the burden of administering the licensing scheme, including verifying build out.<sup>224</sup>

108. Many commenters addressed the issue of license area size. Six commenters supported license areas that are consistent with the current fixed terrestrial regime at 28 GHz and 39 GHz,<sup>225</sup> including four incumbent fixed licensees.<sup>226</sup> Several commenters pointed out that the characteristics of millimeter wave spectrum suggest that large service areas would not be advisable.<sup>227</sup> Finally, two commenters stated that development of millimeter wave technology is too nascent to make informed determinations about license area, and one criticized large license area sizes as being inappropriate for millimeter wave technology.<sup>228</sup>

109. *Discussion.* If we adopt a geographic area approach for licensing these bands as we proposed above, then we must determine the appropriate size(s) of service areas on which licenses should be based. We seek to adopt service areas for all bands that meets several statutory goals. These include facilitating access to spectrum by both small and large providers, providing for the efficient use of the spectrum, encouraging deployment of wireless broadband services to consumers, including those in rural areas and tribal lands, and promoting investment in and rapid deployment of new technologies and

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<sup>223</sup> *NOI*, 29 FCC Rcd at 13046 ¶ 96.

<sup>224</sup> *Id.*

<sup>225</sup> See, e.g., Samsung Reply Comments at 6, NYU Wireless Comments at 34.

<sup>226</sup> FiberTower Comments at 16-17, XO Communications Comments at 5 n.12, Straight Path Comments at 25, T-Mobile Comments at 7.

<sup>227</sup> NYU Wireless Comments at 34, 53, ViaSat Comments at 12.

<sup>228</sup> Nokia Comments at 31-32, T-Mobile Comments at 8-9, O3b Comments at 4.

services consistent with our obligations under Section 309(j) of the Communications Act.<sup>229</sup> In order to accomplish these goals, we must take into account the unique characteristics and circumstances in each specific band. We agree with CEA that the characteristics of millimeter wave spectrum must be taken into account in determining “both the geographic scope of licenses and performance requirements,” including the fact that licensees may not initially want or need to serve an entire BTA to meet its or its customers’ needs.<sup>230</sup>

110. We propose to use counties as the base geographic area unit for licenses in the 28 GHz, 39 GHz, and 37 GHz bands. Counties are significantly smaller than traditional license areas, such as BTAs and EAs, but are generally larger than the other non-traditional license area the Commission has elsewhere adopted, including census tracts.<sup>231</sup> There are currently 3,143 counties,<sup>232</sup> in comparison to 176 EAs, 493 BTAs, and more than 74,000 census tracts.

111. We believe there may be several advantages to county-based licenses. First, we believe county licenses best fit the localized types of services we expect to be offered in the mmW bands. These bands do not propagate well over long distances, and when used in mobile applications, are expected to provide coverage of areas measured in meters, not kilometers. Second, establishing smaller licenses could provide licensees with additional flexibility to target their deployments to those areas where they need the capacity. Under the existing framework in 28 GHz and 39 GHz, a licensee must meet buildout for its entire BTA or EA or lose its license. Establishing smaller license areas will allow licensees to base their deployment decisions on market forces and customer demand. If it does not make business sense for a licensee to build in a particular county, it can sell or lease the license for that county. Third, smaller license areas reduce the potential for warehousing spectrum; again, licensees will be more likely to acquire and hold only the licenses they need to meet their customers’ demand. Fourth, county based licenses could equally facilitate access by both small carriers and large carriers. Smaller license areas allow smaller carriers to better tailor their spectrum acquisitions to the locations for which they need it the most. Smaller license areas would facilitate access by larger carriers because such carriers could both narrowly target the areas in which they need the additional spectrum or aggregate the counties—which serve as the building blocks for traditional license areas<sup>233</sup>—into larger license areas, thus achieving economies of scale.

112. We believe that, in accomplishing our statutory objectives, it is advantageous that counties greatly vary in size, population, and demographics.<sup>234</sup> We expect that there will be prospective providers who wish to serve areas in more than one county, as well as prospective providers with more limited business plans seeking to serve a single, small county or a partitioned county. And finally, as discussed below, we propose to allow FSS operators to acquire licenses in these bands, which will confer on the FSS operator the right to exclude other users. We believe counties are an appropriate size to allow FSS operators to seek the protection they might desire through the license without over or under excluding other uses or users.

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<sup>229</sup> 47 U.S.C. § 309(j).

<sup>230</sup> CEA Comments at 13.

<sup>231</sup> See Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, GN Docket No. 12-354, *Report and Order and Second Further Notice of Proposed Rulemaking*, 30 FCC Red 3959, 3991 ¶ 96 (2015) (“3.5 GHz Report and Order”).

<sup>232</sup> See U.S. Census Bureau Press Release, “2010 Census Shows Nation’s Hispanic Population Grew Four Times Faster than Total U.S. Population” (May 26, 2011) (stating that there are 3,143 counties in the U.S.), [available at http://www.census.gov/2010census/news/releases/operations/cb11-cn146.html](http://www.census.gov/2010census/news/releases/operations/cb11-cn146.html).

<sup>233</sup> See Description of FCC Areas by the Office of Engineering and Technology (OET), [available at http://transition.fcc.gov/oet/info/maps/areas/](http://transition.fcc.gov/oet/info/maps/areas/).

<sup>234</sup> See U.S.A. Counties Database, U.S. Census Bureau, [available at http://censtats.census.gov/usa/usa.shtml](http://censtats.census.gov/usa/usa.shtml).

113. We seek comment on alternative geographic area sizes that could be used as the basis for licensing spectrum in these bands. For 28 GHz and 39 GHz, should we maintain the existing larger license areas of BTAs or EAs, respectively? Would maintaining the existing license areas provide any advantages in facilitating deployment of those bands? We also seek comment on license areas historically used by the Commission such as PEAs, census blocks, or block groups. If we do not license local area rights in the 37 GHz band by rule, using a geographic area approach might allow for a greater mix of local area and wide area licensed uses in the same band. In that case, we may wish to adopt geographic license areas small enough to accommodate local area users without extensive partitioning of large licenses. For example, we could define license areas based on census blocks or block groups. This might allow for a greater mix of local area and wide area licensed uses in the same band compared to traditional license areas, which typically encompass an entire metropolitan region and its surrounding area. We also seek input from FSS operators on the appropriate license area size that would accommodate their participation in the market-based mechanism described below to accommodate potential further FSS use of these bands.<sup>235</sup> Balancing the need for sufficient geographic separation and license areas that are not unnecessarily large, are counties an appropriate license size for potential FSS use, or would smaller or larger license areas be more appropriate? We ask commenters to discuss and quantify the economic, technical, and other public interest considerations of licensing these bands using the particular geographic area they advocate.

114. *Treatment of Existing 28 GHz and 39 GHz Licenses.* We recognize that there are existing LMDS and 39 GHz licenses that are licensed on a BTA or EA basis, respectively. Specifically, in 1997, the Commission determined that LMDS would be licensed using the BTA geographic service areas in the 1992 Commercial Atlas and Marketing Guide, published by Rand McNally, that identifies 487 BTAs based on the 50 States. It also added six geographic areas for licensing in the U.S. territories to be included as BTAs.<sup>236</sup> In 1997, the Commission initially determined that the 39 GHz band would be licensed on a BTA basis.<sup>237</sup> This decision was based on our expectation at the time that the Commission would execute licensing agreements similar to those it had in other services.<sup>238</sup> By 1999, subsequent developments led the Commission to conclude that adopting BTAs for 39 GHz could unnecessarily delay the licensing process.<sup>239</sup> Thus, on its own motion, the Commission reconsidered its license area determination and, based on the record in the proceeding, decided to license all channel blocks in the 39 GHz band using Economic Areas.<sup>240</sup>

115. We propose to subdivide existing LMDS and 39 GHz licenses on a county basis, consistent with our proposal to offer licenses on a county basis for spectrum currently held in inventory. This ensures that both the existing and future licenses are uniform in their size and rights, and will facilitate a multiplicity of uses and users. In addition, because counties nest into both BTAs and EAs, incumbent licensees retain the exact same coverage, and increase their flexibility to tailor the license holdings to meet their business needs. Under our proposal, if a licensee holds a BTA or EA license consisting of eight counties, it would receive a separate license for each county in the BTA or EA, for a total of eight licenses. Existing licensees will otherwise keep the full package of license rights they currently hold (with the addition of new mobile rights). While we could keep the existing BTA or EA

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<sup>235</sup> See Section IV.C, *infra*.

<sup>236</sup> Specifically, the Commission added BTAs for U.S. Virgin Islands, American Samoa, Guam, San Juan, Puerto Rico, Mayaguez Puerto Rico, and the Northern Mariana Islands.

<sup>237</sup> *39 GHz R&O*, 12 FCC Rcd at 18610-11.

<sup>238</sup> Amendment of the Commission's Rules Regarding the 37.0-38.6 GHz and 38.6-40.0 GHz bands, ET Docket No. 95-183, *Memorandum Opinion and Order*, 14 FCC Rcd 12428, 12452 ¶ 46 (1999).

<sup>239</sup> *Id.*

<sup>240</sup> *Id.* at 12452-12453 ¶ 46.

licenses as is, subdividing the licenses would create a uniform nationwide license structure. We seek comment on this proposal.<sup>241</sup>

#### 4. Band Plan for the 28 GHz, 27 GHz, and 39 GHz Bands

116. We seek comment on our proposed band plans for the 28 GHz, 37 GHz, and 39 GHz bands. For the 28 GHz band, we propose to use the existing band plans in place for LMDS. Specifically, the 27.5-28.35 GHz band is currently licensed as a single block (LMDS Channel A1). We believe that continuing to license this band as a single block would be in the public interest because it would provide a wide band (850 megahertz) of contiguous spectrum that could be used to provide high-speed service. Samsung supports this proposal.<sup>242</sup> In contrast, Straight Path supports subdividing the band into a 500 megahertz block and a 350 megahertz block, although its proposal is dependent on the availability of the 29.1-29.25 GHz and 31-31.3 GHz bands.<sup>243</sup> Should we consider subdividing this band into multiple channels, and if so, how? Proponents of subdividing the band should provide analyses showing that multiple operators could provide service in the band.

117. We also propose to continue using the existing 39 GHz band plan. The 39 GHz band is subdivided into 14 channel pairs. Each channel pair has 50 megahertz by 50 megahertz of spectrum (totaling 1.4 gigahertz).<sup>244</sup> We recognize that Samsung and Straight Path recommend that the band be reconfigured for wider channels.<sup>245</sup> On balance, we believe that keeping the existing band plan would promote expeditious deployment, consistent with our proposal to grant rights to current licensees, and provide a uniform nationwide band plan. We seek comment on this proposal, as well as proposals for larger channels. What is the cost of adopting a channel scheme that might vary between the current licenses and new initial licenses issued by competitive bidding (*i.e.*, if the current licenses continue to follow the current band plan, but the newly created licenses subject to auction have a different band plan)? We also seek comment on Straight Path's proposal to allow incumbent licensees to exchange licenses within a market so that incumbents can obtain contiguous spectrum.<sup>246</sup>

118. We also seek comment on a band plan for the 37 GHz band. One possibility would be to subdivide the band into three equal blocks of approximately 533 megahertz each. Another possibility would be to have four blocks of 400 megahertz each. Those plans would potentially provide multiple channels, each capable of supporting high-rate communications. If we chose to have separate bands for local area uses and outdoor deployments, we could have separate band segments for each use. We seek

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<sup>241</sup> We do not believe that subdividing the existing LMDS and 39 GHz licenses would constitute a modification of license within the meaning of Section 316 of the Communications Act because the change would not affect the substantive operating rights of the existing licensee. Moreover, to the extent the change modifies existing licenses, the Commission may effectuate such a change on a licensee-wide basis pursuant its rulemaking authority, without triggering the procedural requirements of Section 316. *See* Review of the Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Service Systems in the 1.6/2.4 GHz Bands, IB Docket No. 02-364, Report and Order, Fourth Report and Order, and Further Notice of Proposed Rulemaking, 19 FCC Rcd 13356, 13393 ¶ 85 (2004) (Section 316 does not apply to modification of spectrum sharing plan adopted by a rulemaking proceeding that affects all Mobile Satellite Service providers), *citing California Citizens Band Association v. FCC*, 375 F.2d 43, 51-52 (9th Cir. 1967).

<sup>242</sup> Samsung Aug. 28 *Ex Parte* at 3.

<sup>243</sup> Straight Path Sep. 11 *Ex Parte* at 3.

<sup>244</sup> *See* 47 C.F.R. § 101.147(v).

<sup>245</sup> Samsung Aug. 28 *Ex Parte* at 3 (band segments of 37-38 GHz, 38-39 GHz, 39-39.4 GHz, 39.4-39.6 GHz, 39.6-39.8 GHz, 39.8-39.85 GHz, 39.85-39.9 GHz, 39.9-39.95 GHz, and 39.95-40 GHz); Straight Path Sep. 11 *Ex Parte* at 3 (two 500 megahertz segments (39-39.5 GHz and 39.5-40 GHz) and a 400 megahertz segment (38.6-39 GHz)).

<sup>246</sup> Straight Path Sep. 11 *Ex Parte* at 4.

comment on alternative band plans. Commenters should address how their preferred plans would support a wide variety of services while maximizing access to spectrum.

## 5. License Term

119. *Background.* License terms generally vary based upon the type of service authorized and the purpose for which a service was created. Under existing rules, fixed licensees in the 28 GHz and 39 GHz bands licensed under Part 101 will have a license term not to exceed 10 years.<sup>247</sup> In the *Second LMDS Report and Order*, the Commission adopted a 10-year term for 28 GHz licensees.<sup>248</sup> The Commission found that this license term was consistent with the rules governing other Part 101 services, and that it served our goal of providing licensees with flexibility to develop this spectrum as the market demands and to employ innovative technologies which may not be available immediately upon licensing.<sup>249</sup> At 39 GHz, all common carrier 39 GHz licensees that were licensed before August 1, 1996 (*i.e.*, those licensed previously under Part 21 of our Rules) were subject to a fixed license term ending February 1, 2001, regardless of the grant date of their individual licenses.<sup>250</sup> Private carrier 39 GHz licensees authorized before August 1, 1996 (*i.e.*, those licensed previously under Part 94 of our Rules) were subject to a fixed five-year license, which would run from the date of license grant.<sup>251</sup> However, when the Commission adopted its Part 101 Report and Order, it determined that both private and common carrier licenses granted on or after August 1, 1996, would have a license term not to exceed ten years.<sup>252</sup> Finally, terrestrial service rules currently do not exist for the 37 GHz band, so no license term has been specified for that band.

120. We did not seek comment specifically on the issue of license terms in the *NOI*. Only one commenter, Qualcomm, directly addressed this issue by stating that the FCC should adopt a 10-year license term in conjunction with reasonable performance requirements.<sup>253</sup>

121. *Discussion.* We propose to establish a 10-year term for all licenses in the 28 GHz, 37 GHz, and 39 GHz bands.<sup>254</sup> We believe this length of license term will help to maintain consistency within these bands. Many of the fixed licenses in these bands are already subject to 10-year license terms, including fixed licensees in the LMDS band and fixed licensees in the 39 GHz band that were licensed after August 1, 1996.<sup>255</sup> As discussed above, we propose to grant mobile operating rights to existing LMDS and 39 GHz licensees.<sup>256</sup> If we adopt that proposal, we believe the most seamless, consistent, and expedient path for license terms would be to also adopt 10-year terms for all licensees in these bands.

122. We seek comment on our proposal to adopt a 10-year license term, including any costs and benefits of the proposal. We also seek comment on whether licensees should receive a renewal expectancy for subsequent license terms if they continue to provide at least the level of service required at the end of their initial license terms through the end of any subsequent license terms. In addition, we invite commenters to submit alternate proposals for the appropriate license term, which should similarly

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<sup>247</sup> 47 C.F.R. § 101.67.

<sup>248</sup> *Second LMDS Report and Order*, 12 FCC Rcd at 12656 ¶ 259.

<sup>249</sup> *Id.* at 12656-12657 ¶ 259.

<sup>250</sup> *39 GHz R&O*, 12 FCC Rcd at 18621 ¶ 36.

<sup>251</sup> *39 GHz R&O*, 12 FCC Rcd at 18621 ¶ 36.

<sup>252</sup> *39 GHz R&O*, 12 FCC Rcd at 18621 ¶ 36.

<sup>253</sup> Qualcomm Comments at 17.

<sup>254</sup> We note, however, that if we were to adopt the re-auction concept discussed below, we would likely adopt a shorter license term, such as 5 years. *See infra* at ¶¶ 255-256.

<sup>255</sup> *See* ¶ 119, *supra*.

<sup>256</sup> *See* Section IV.B.1, *supra*.

include a discussion on the costs and benefits. For instance, we note that in the *3.5 GHz R&O* the Commission adopted three year license terms on the theory that the band will be used in a flexible manner that supports myriad uses, providing spectrum to users where and when they need it.<sup>257</sup> Would a five year term for these bands be appropriate under a similar rationale?

123. Under our 10-year license term proposal, if a license in these bands is partitioned or disaggregated (as discussed in further detail below), we propose that any partitionee or disaggregatee would be authorized to hold its license for the remainder of the partitioner's or disaggregator's original license term.<sup>258</sup> This approach is similar to the partitioning provisions the Commission adopted for other services.<sup>259</sup> We emphasize that nothing in our proposal is intended to enable a licensee, by partitioning or disaggregating the license, to confer greater rights than it was awarded under the terms of its license grant. Similarly, nothing in our proposal is intended to enable any partitionee or disaggregatee to obtain rights in excess of those previously possessed by the underlying licensee.

## C. Facilitating Satellite Use of the 27.5-28.35 GHz and 37.5-40 GHz bands

### 1. Background (Current Framework)

124. Nineteen years ago, in the *28 GHz First Report and Order*,<sup>260</sup> the Commission found that co-frequency sharing between LMDS and ubiquitously deployed satellite earth stations was not yet feasible, but said that it would consider revisiting that conclusion if future technology became available to facilitate that type of sharing.<sup>261</sup> Among other band segments, the Commission designated 850 megahertz at 27.5-28.35 GHz for LMDS on a primary basis, and permitted geostationary Fixed-Satellite Service (GSO/FSS) or non-geostationary Fixed-Satellite Service (NGSO/FSS) systems to provide links in that band segment on a non-interference basis to LMDS systems, but only for the purpose of providing limited Earth-to-space gateway-type services.<sup>262</sup> The Commission rejected a proposal to offer limited protection to FSS gateways operating in the 27.5-28.35 band segment, concluding that, if proponents of FSS systems were to implement gateways in that part of the LMDS band, these gateway links would operate on a non-interference-non-protected basis with respect to LMDS operators.<sup>263</sup>

<sup>257</sup> *3.5 GHz R&O*, 30 FCC Rcd at 3994-3997 ¶¶ 105-113.

<sup>258</sup> "Partitioning" is the assignment of geographic portions of a license along geopolitical or other boundaries. "Disaggregation" is the assignment of discrete portions of "blocks" of spectrum licensed to a geographic licensee or qualifying entity. Disaggregation allows for multiple transmitters in the same geographic area operated by different companies on adjacent frequencies (thus increasing the possibility of harmful interference). For further detail, see Section IV.E.8.a *supra*.

<sup>259</sup> See Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules, WT Docket No. 99-168, *First Report and Order*, 15 FCC Rcd 476, 506-08 ¶¶ 74-78 (2000); Reallocation and Service Rules for 698-746 MHz Spectrum Band (Television Channels 52-59), GN Docket No. 01-74, *Report and Order*, 17 FCC Rcd 1022, 1079-81 ¶¶ 152-157 (2002); Geographic Partitioning and Spectrum Disaggregation by Commercial Mobile Radio Services Licensees, WT Docket No. 96-148, GN Docket No. 96-113, *Report and Order and Further Notice of Proposed Rulemaking*, 11 FCC Rcd 21831, 21870 ¶¶ 76-77 (1996); Amendment of Parts 21 and 74 of the Commission's Rules With Regard to Filing Procedures in the Multipoint Distribution Service and in the Instructional Television Fixed Service, MM Docket No. 94-131, PP Docket No. 93-253, *Report and Order*, 10 FCC Rcd 9589, 9614 ¶ 46 (1995).

<sup>260</sup> In the Matter of Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed-Satellite Services, CC Docket No. 92-297, 11 FCC Rcd 19005 (1996) ("*28 GHz First Report and Order*").

<sup>261</sup> *28 GHz First Report and Order*, 11 FCC Rcd at 19015-19016 ¶ 27.

<sup>262</sup> *28 GHz First Report and Order*, 11 FCC Rcd at 19025 ¶ 45.

<sup>263</sup> *28 GHz First Report and Order*, 11 FCC Rcd at 19026 ¶ 48.

125. With regard to the 37.5-40 GHz band, in 2003 the Commission preserved the co-primary status of FSS for space-to-Earth transmissions, but implemented a “soft segmentation” plan that favored terrestrial Fixed Service and terrestrial Mobile Service, which also have co-primary allocations in that band.<sup>264</sup> The soft segmentation plan limited FSS to gateway-type earth station operations in the 37.5-40 GHz band, and it prohibited the ubiquitous deployment of satellite earth stations designed to serve individual consumers.<sup>265</sup> The plan also established clear-sky power flux density (PFD) limits for satellite transmissions in the 37.5-40 GHz band that are 12 dB lower than the level allowed for satellite transmissions in the 40-42.5 GHz band.<sup>266</sup> However, in the subsequent *V-Band Third FNPRM* in 2010, the Commission proposed to allow satellite operators to increase their PFDs during heavy rain storms to overcome signal attenuation under those conditions.<sup>267</sup>

126. For the reasons discussed below, we believe that it is appropriate to review both sets of decisions in light of evolutions in technology, the introduction of mobile, and the possibility of leveraging market-based mechanisms to coordinate coexistence issues and future FSS expansion in these bands.<sup>268</sup>

## 2. Ka-Band Gateway Earth Stations

### a. Request for Upgraded Status in 28 GHz Band

127. EchoStar and the FSS Operators ask the Commission to upgrade gateway earth stations in the 28 GHz band from secondary status to co-primary status.<sup>269</sup> They argue that the secondary status has hindered satellite investment and that satellite operators “must have regulatory certainty about their continued access to this spectrum for existing, as well as new, gateway earth stations.”<sup>270</sup> They also argue that experience has shown that gateway earth stations have been able to successfully co-exist with fixed LMDS licensees.<sup>271</sup> XO, which holds 91 LMDS licenses, argues that granting satellite operators co-primary status in the 27.5-28.35 GHz band “could encumber existing LMDS licensees’ spectrum and potentially frustrate their efforts to build out fixed wireless and 5G systems.”<sup>272</sup>

128. ViaSat recommends a different approach: that the Commission review past decisions that constrained opportunities for spectrum sharing and evaluate them in the light of contemporary technologies and techniques.<sup>273</sup> ViaSat acknowledges that the industry committee that was formed in 1996 to develop negotiated proposed rules for the LMDS in the Ka-band identified a number of

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<sup>264</sup> The soft-segmentation plan favors FSS in the 40-42.5 GHz band, consistent with a soft segmentation plan adopted by the 2000 World Radiocommunication Conference. In the Matter of Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations, *Second Report and Order*, 18 FCC Rcd 25428, 25432, 25433-25434 ¶¶ 8, 12-14 (2003) (“*V-Band Second Report and Order*”).

<sup>265</sup> *V-Band Second Report and Order*, 18 FCC Rcd at 25442 ¶ 33.

<sup>266</sup> *V-Band Second Report and Order*, 18 FCC Rcd at 25438-25439 ¶¶ 23-24.

<sup>267</sup> *V-Band Third FNPRM*, 25 FCC Rcd at 15674-15683 ¶¶ 30-55.

<sup>268</sup> Recognizing that IB Docket No. 97-95 has remained open since the *V-Band Third FNPRM* was issued five years ago, we incorporate the record in that proceeding by reference into this proceeding, and invite further comment on the issues raised in that notice.

<sup>269</sup> EchoStar Comments at 24, FSS Operators Comments at 4.

<sup>270</sup> EchoStar Comments at 24, FSS Operators Comments at 4.

<sup>271</sup> FSS Operators Comments at 3.

<sup>272</sup> XO Reply Comments at 5-6 n.20, XO Comments at 2.

<sup>273</sup> See ViaSat Reply Comments at 4-8.

techniques that could enable sharing of widely deployed FSS transmitters and LMDS receivers, including cognitive radio technologies and mitigation techniques, such as FSS monitoring of LMDS transmissions before transmitting and requiring that a database of LMDS subscribers be maintained, but did not come to an agreement about those techniques, in part because of concerns about the commercial viability of those approaches in 1996.<sup>274</sup> Regardless of whether those types of sharing techniques were mature when plans for the Ka-band and the V-band were adopted, says ViaSat, the fact remains that those techniques are readily available today, and in fact have been endorsed by the Commission in other proceedings as essential means of making more intensive use of spectrum.<sup>275</sup> ViaSat notes that similar techniques are used by unlicensed devices operating in TV white spaces are required to employ geolocation/database access and spectrum sensing capabilities that enable the user device to listen for and identify the presence of signals from other transmissions.<sup>276</sup>

129. *Discussion.* We believe there should be a mechanism under which satellite earth stations could acquire co-primary status where their owners believe that such a level of protection is necessary. Accordingly, we seek comment on establishing a market-based mechanism for allowing proposed gateway earth stations to acquire co-primary status by acquiring flexible use terrestrial licenses. Specifically, we propose that a Part 25 FSS earth station would have co-primary status if its licensee also holds the corresponding terrestrial license<sup>277</sup> for the location of that earth station.

130. We believe it is not in the public interest to automatically grant co-primary status for FSS operations in the 27.5-28.35 GHz band at this time. The main disadvantage of designating FSS gateway earth stations as co-primary at this time is that it could be inconsistent with the development of terrestrial Mobile Service in the band. If we made gateway earth stations co-primary in the 28 GHz band, existing FSS operators could unilaterally place gateway earth stations anywhere there was no current licensee (or where they could successfully coordinate with other co-primary users). On the other hand, terrestrial licensees would not be in place until after service rules were established and licenses were assigned. By that time, there could be areas where it would not be possible to implement terrestrial service because of the presence of previously-licensed FSS gateway earth stations. While there should be a mechanism for accommodating gateway earth stations in the 28 GHz band, that mechanism should also be consistent with terrestrial use of the band.

131. At the same time, we agree with EchoStar, the FSS Operators, and ViaSat that there should be additional mechanisms for accommodating gateway earth stations in the 28 GHz band. In particular, we agree with ViaSat that it might be feasible to allow satellite operators to make greater opportunistic use of the LMDS band for gateway earth stations. We note that FSS Operators, O3B, and ViaSat agree that they have been able to coexist with LMDS operations through planning and coordination.<sup>278</sup> Recognizing the balance we are proposing to strike between incumbent operations and new flexibility in this band, we seek comment on the ability of mobile and FSS operations to coexist, and ways to facilitate coexistence that are mutually effective for both FSS and future mobile operators.

132. One way to protect gateways from being superseded by subsequent terrestrial deployments would be for FSS operators to obtain the terrestrial licensees, either by participating in Commission auctions or by purchasing them from existing Upper Microwave Flexible Use licensees. Since there are no proposed eligibility restrictions on Upper Microwave Flexible Use licenses that would

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<sup>274</sup> ViaSat Reply Comments at 4-5 n.9, *citing* Report of the LMDS/FSS 28 GHz Band Negotiated Rulemaking Committee, CC Docket No. 92-297, at 43 and 45 (filed Nov. 9, 1994).

<sup>275</sup> ViaSat Reply Comments at 7-8.

<sup>276</sup> ViaSat Reply Comments at 7-8, *citing* Unlicensed Operation in the TV Broadcast Bands, ET Docket No. 04-186, *Second Report and Order*, 23 FCC Rcd 16807, 16836, 16852 ¶¶ 72, 125 (2008) and 47 C.F.R. §§ 15.711, 15.713.

<sup>277</sup> As discussed below, we propose to create a new radio service, the Upper Microwave Flexible Use Service.

<sup>278</sup> FSS Operators Comments at 3, O3B Comments at 8, ViaSat Comments at 10-11.

specifically limit the ability of FSS providers to acquire these licenses, there is no legal impediment to FSS operators acquiring a terrestrial license. In this case, the license right that an FSS provider may benefit from and value the most is the right to exclude other users from the geographic area of the license. That right in effect allows them to achieve co-primary status and would provide the protection the FSS providers' seek. From the FSS operator's perspective, the most convenient variant of this approach might be to obtain a partitioned license.

133. Allowing non-Federal FSS operators to acquire flexible use licenses to obtain co-primary status would have several advantages. First, it would establish a market-based mechanism for determining the highest and best use of the spectrum in a given area. In those areas where there is little demand for terrestrial service, or where such service can coexist with gateway earth stations, FSS operators can acquire co-primary status. On the other hand, this mechanism need not unduly burden the development of terrestrial mobile or fixed service, especially where FSS operators opt only to obtain partitioned portions of licenses, because FSS operators will have little incentive to buy territorial rights any larger than they will need to ensure the continued operation of their gateways.<sup>279</sup> Second, this approach would allow licensees to use the 28 GHz band to provide a wide variety of services to consumers and businesses. Third, both satellite and terrestrial operators would obtain additional flexibility to adjust their operations to meet consumer demand. If a licensee acquires a license with the intent to provide mobile service but later determines that there is insufficient demand for such service, it would have the option of selling that license to an FSS operator if that operator is interested in placing an earth station in that area. FSS operators would have similar flexibility. That flexibility would help ensure that spectrum ends up in the hands of someone who is willing and able to use the spectrum to provide service.

134. By obtaining Upper Microwave Flexible Use licenses—or portions thereof—FSS operators would be able to prevent incursions by terrestrial operators that might otherwise require them to shut down their FSS gateways. We emphasize, however, that an Upper Microwave Flexible Use license would not authorize operations of the FSS earth stations. The licensing of earth stations would continue to be governed by our Part 25 licensing rules. We further emphasize that, by auctioning Upper Microwave Flexible Use licenses or allowing the transfer of partitioned portions of those licenses to companies that operate FSS systems, we would not be auctioning orbital slots or the right to operate a satellite system. Any such authorization would require a separate license issued pursuant to Part 25 of the Commission's Rules. Accordingly, the fact that the Upper Microwave Flexible Use licenses would be subject to auction would not be contrary to Section 647 of the Open-market Reorganization for the Betterment of International Telecommunications Act,<sup>280</sup> which states, "the Commission shall not have the authority to assign by competitive bidding orbital locations or spectrum used for the provision of international or global satellite communications services."<sup>281</sup> As is clear from our description, an FSS provider taking advantage of this flexibility would be acquiring a terrestrial license, for terrestrial operations, that also has the effect of protecting a gateway in the service area by virtue of the right to exclude conferred through the license.

135. In proposing the alternative discussed above, we do not intend to limit the ability of FSS operators to continue availing themselves of other, existing alternatives. We also emphasize that we would not require FSS operators to acquire an Upper Microwave Flexible Use authorization to operate in this band. In particular, FSS operators would continue to have the option of applying for earth station authorizations on a secondary basis under our existing rules. They would also remain free to negotiate

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<sup>279</sup> Since these are transmitting earth stations, the area needs only be large enough to ensure that no constraints are imposed on terrestrial operations outside that area.

<sup>280</sup> 47 U.S.C. § 765(f).

<sup>281</sup> See *Northpoint Technology, Ltd. v. FCC*, 412 F.3d 145 (D.C. Cir. 2005)

private interference agreements with Upper Microwave Flexible Use licensees. The purpose of our proposal is to give FSS operators another possible means to expand opportunistic use of the 28 GHz band.

136. *Treatment of Existing 28 GHz FSS Earth Stations.* There are currently 21 FSS earth stations licensed in the 28 GHz band on a secondary basis, and 17 pending applications. About half of those earth stations (or proposed earth stations) are located within the service area of an active LMDS license authorized to operate in the 28 GHz band. The other half are located in areas where there is no active LMDS license in the 28 GHz band. We seek comment on the proposals described below for future treatment of those earth stations, as well as alternatives.

137. We propose that earth stations located within the service area of an active LMDS license maintain their secondary status. Those FSS operators constructed their facilities knowing that their operations would be on a secondary basis. LMDS licensees purchased their licenses at auction with the understanding that their fixed and point-to-multipoint operations would have priority over FSS operations. These LMDS licensees have also successfully demonstrated substantial service.<sup>282</sup> Under those circumstances, we propose not to upgrade FSS operations at the expense of LMDS licensees. To the extent that FSS operators and LMDS licensees have private agreements concerning protection of their facilities, those agreements would continue in force and effect. We also note that depending on the terms of those agreements, the FSS operator may obtain protection which is based on the terms of the agreement and the primary nature of the LMDS license.

138. We have attempted to balance the introduction of mobile on a primary basis, with the investment and expectation of continued operation by FSS providers. Recognizing the services' status in the U.S. Table of Allocations, what is the extent to which mobile and FSS can coexist in a shared environment? Technically, to what extent do FSS providers anticipate that their operations may cause interference to mobile services? In the event that parties believe there are issues of coexistence that cannot be resolved through direct discussions between the mobile and FSS operations, are there regulatory approaches that could facilitate coexistence between the two services without having a negative impact on future mobile deployment?

139. With respect to FSS earth stations located outside the license area of an LMDS licensee, we believe it could be in the public interest to provide a mechanism for those earth stations to upgrade to co-primary status. In those areas, the most common reason for cancellation of the LMDS license was failure to demonstrate substantial service. Demand for fixed LMDS service in those areas was therefore apparently limited. To the extent an FSS earth station is operating and providing service, it could be appropriate to upgrade the earth station to co-primary status in those areas where the former LMDS licensee did not construct. Upgrading the status of those earth stations could give the FSS operator an incentive to make additional investment in those facilities because it would have certainty that the earth station would not have to shut down in order to protect primary users of the spectrum. In addition, there is no LMDS licensee who can claim prejudice from that action. As with the proposal in the previous paragraph, this proposal attempts to balance the introduction of mobile on a primary basis, with the investment and expectation of continued operation by FSS providers. We therefore seek comment on the same issues of interference and facilitating co-existence for this proposal as we did for that other proposal.

140. We seek comment on the following mechanism for upgrading existing FSS earth stations located outside the service area of an active LMDS license. Prior to holding an auction, the Commission would open a closed filing window for Upper Microwave Flexible Use licenses. The filing window would be restricted to FSS licensees with an earth station within the census tract (or other area we may adopt) of the proposed license. The FSS earth station licensee would have the opportunity to apply for a license including the license area where the earth station was located. Because the filing window would be restricted to the FSS operator, there would be no mutual exclusivity. Once the FSS operator was

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<sup>282</sup> See 47 C.F.R. § 101.1011.

issued the Upper Microwave Flexible Use license, it would have co-primary status. Adopting this approach would give FSS operators certainty that they could obtain co-primary status covering a significant number of the existing sites. This mechanism would also integrate existing earth stations into the flexible, market-based framework we are adopting for the 28 GHz band. In the subsequent Upper Microwave Flexible Use license auction, initial licenses for any geographic area awarded pursuant to the closed filing window would not be offered.

141. In commenting on this mechanism, we ask parties to address the following issues. First, what criteria should we use for determining that an earth station is in operation and providing service? One possible set of criteria might include the earth station being in communication with one or more satellites, being connected to fiber (or other backhaul facilities), and having customer data actively being transmitted over the earth station. Second, what license area should we use for licenses offered to the FSS licensees in a potential closed filing window? Is a census tract the appropriate area size license to award? Are there circumstances under which an FSS operator may need to acquire a larger license area in order to avoid interference? In establishing a license area size to award for an FSS earth station, our goals would be to ensure protection to the earth station while minimizing the impact on terrestrial service in adjacent areas. Third, would it serve the public interest to set up a process to allow, through a market-based approach or otherwise, future earth stations in the same license area?

142. We also seek comment on alternative mechanisms of upgrading FSS earth stations that are not within the service area of an LMDS licensee to co-primary status. Commenters should keep in mind that there appear to be advantages to adopting a flexible licensing framework that results in FSS operators holding Upper Microwave Flexible Use licenses.

143. *Future 28 GHz Earth Stations.* We propose that future FSS operators can obtain Upper Microwave Flexible Use licenses at auction to eliminate potential interference concerns with terrestrial operations in their areas. We recognize that FSS operators may wish to apply for earth stations in the 28 GHz band during the period of time that precedes the auction for Upper Microwave Flexible Use licenses. Until we issue new rules, such licenses will continue to be issued on a secondary basis. If the earth station is within the service area of an existing LMDS licensee, the FSS operator may enter into an agreement with the primary licensee or acquire the LMDS or Upper Microwave Flexible Use license in the secondary market in order to upgrade its status.

144. If the proposed earth station is sought before the auction for licenses outside the service area of an LMDS licensee, we must balance several competing interests. The FSS operator has an interest in obtaining protection for its earth station. On the other hand, depending on the location of the earth station, granting co-primary status could hinder future terrestrial deployment in the 28 GHz band. If we automatically granted co-primary status to all earth station applicants who file between the release of this *NPRM* and the auction for Upper Microwave Flexible Use licenses, there could be a substantial negative impact on future growth of the band. Conversely, earth stations located in remote areas could be granted co-primary status with little or no impact on future terrestrial deployment.

145. We propose to use a waiver process to address this situation. Under our proposal, 28 GHz earth station applicants may seek a waiver of their secondary status and request co-primary status if they can demonstrate that their presence would be unlikely to have a negative impact on future terrestrial service. A primary factor we propose to consider in evaluating the waiver request would be the location of the proposed earth station. For instance, we would be more likely to favorably act on a request if an earth station applicant proposes to locate in a remote area where terrestrial service is unlikely to be deployed shortly after the auction. On the other hand, earth stations located in populated areas where there is likely to be demand for terrestrial service would bear a heavy burden of justifying a waiver. We could also consider steps the earth station applicant proposes to minimize its impact on terrestrial operations, such as natural or artificial shielding of the earth station site, or limiting its emissions towards low elevation angles. If the earth station applicant receives a waiver, and the earth station is operating and providing service at the time of the closed filing window, we propose that it would be eligible to apply for an Upper Microwave Flexible Use license during the closed filing window as discussed above.

146. We seek comment on using a waiver process to evaluate requests for co-primary status, as well as alternative ways of addressing this issue. Are there additional criteria we should consider in evaluating waiver requests? Are there other ways of evaluating such requests?

### 3. Repealing Restriction on FSS Fixed User Equipment in 28 GHz Band

147. As noted above, FSS use of the 28 GHz band is limited to gateway earth stations.<sup>283</sup> While we anticipate that terrestrial service will remain primary in this band, we seek comment on whether it is possible to allow deployment of fixed FSS user equipment on a secondary basis, subject to the condition that the user equipment not cause interference to fixed or mobile operations. In that regard, we propose that Upper Microwave Flexible Use Service licensees be required to provide information on their fixed and mobile deployments in order to facilitate sharing. We also seek comment on several possible technical mechanisms by which sharing could be implemented.

148. While some commenters take the position that sharing between terrestrial and widespread satellite operations in the mmW bands will be difficult or impossible,<sup>284</sup> the overwhelming majority of commenters who address the issue say that the propagation characteristics of mmW signals will make it much easier to manage spectrum sharing, compared with lower bands of spectrum where signals propagate around obstacles or beyond horizons.<sup>285</sup> Samsung expresses optimism that sharing will be feasible but says that it would be helpful to have additional information about the technical parameters of potentially affected satellite systems, and notes that O3b has already provided extremely helpful information about the technical parameters of its satellite system and is proactively seeking similar relevant information about the terrestrial mobile systems being developed for the mmW bands.<sup>286</sup>

149. In this section, we seek comment on several possible ideas for facilitating the deployment of FSS user equipment on a secondary basis. We seek comment on these ideas, as well as alternative ideas commenters wish to present. To the extent commenters believe a proposal will impose undue burdens, we encourage those commenters to describe the burden in detail and to provide detailed information on the costs involved. We also encourage commenters to discuss how these proposals would affect a variety of use cases for the mmW bands, including fixed, mobile, and satellite uses. We also seek comment on the extent to which private agreements between FSS operators and terrestrial licensees could facilitate sharing. Should we allow private agreements to supplement or replace any regulatory mechanisms we might establish to facilitate sharing? Could private agreements render rules unnecessary in this area? We seek comment on these issues.

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<sup>283</sup> *28 GHz First Report and Order*, 11 FCC Rcd at 19025 ¶ 45.

<sup>284</sup> Avanti Comments at 2 (there is no prior case where high-density mobile service has successfully shared spectrum with ubiquitously deployed satellite Earth stations); Straight Path Comments at 20 (the wide beamwidth of mobile station antennas and large radii of satellite spot beams preclude sharing); Vivint Comments at 4 (even modest exclusion zones around thousands of terrestrial stations would effectively prohibit sharing); SpaceX Reply Comments at 6 (aggregate interference from terrestrial operations could adversely impact satellite receive operations); Robert W. Heath Comments at 4 (ubiquitously deployed mobile services could cause harmful interference to FSS).

<sup>285</sup> See Samsung Comments at 44 and Appendix E (1 km separation distance will prevent mobile base station from interfering with satellite earth station); ViaSat Comments at ii (innovative sharing techniques such as cognitive sharing can facilitate efficient use of spectrum); Nokia Comments at 13 (tight beamwidths and high path loss of millimeter wave signals will facilitate sharing); Google Comments at 8 (propagation and atmospheric absorption characteristics of mmW bands make them well-suited to line-of-sight operations that can be mapped and protected with relative ease); EchoStar Comments at 23 (LMDS is a prime example of how satellite and terrestrial frequency bands can be shared effectively); Intel Comments at 7-8 (extensive use of beamforming will localize transmissions in azimuth and elevation and will minimize interference); WIF Comments at 5 (small wavelengths at mmW frequencies allow novel antenna technology that will support adequate isolation).

<sup>286</sup> Samsung Reply Comments at 22-23.

**a. Spectrum Access System**

150. One possible sharing mechanism would be to develop a spectrum access system (SAS) similar to the system required for the 3.5 GHz band. In that band, the Commission established a roadmap for providing tiered access to shared spectrum on a user-priority basis, and made clear its intention to apply the same kinds of techniques to other bands.<sup>287</sup> In announcing its decision, the Commission said:

Advances in radio and computing technologies provide new tools to facilitate more intensive spectrum sharing. Our new rules use these tools to dissolve some age-old regulatory divisions, between commercial and federal users, exclusive and non-exclusive authorizations, and private and carrier networks. Starting from some of the recommendations of the President's Council of Advisors on Science and Technology (PCAST), these rules incorporate a wide range of viewpoints and information collected through three rounds of notice and comment. Over time, some of the approaches we advance in the 3.5 GHz “innovation band” could lead to greater productivity in other parts of the radio spectrum.<sup>288</sup>

151. ViaSat, T-Mobile, Wireless Innovation Forum and Google support the SAS concept in various scenarios.<sup>289</sup> In particular, ViaSat says it is no longer necessary to impose limitations on satellite user terminals in light of the sharing technologies and techniques that have been proven to facilitate successful non-interfering operations in other bands.<sup>290</sup> It notes that many of the scenarios contemplated in the *NOI* for mobile wireless services in high-band spectrum are conducive to opportunistic uses by small satellite terminals through cognitive sharing techniques (including dynamic spectrum databases) and sophisticated radio technologies (including dynamic beam forming). Terrestrial base stations for mobile operations in the mmW bands will likely have small coverage areas and limited aggregate coverage, ViaSat adds, leaving expansive territory available for satellite operators to make opportunistic use of the same spectrum in nearby areas, based on information regarding the locations and frequencies of terrestrial base stations.<sup>291</sup> Just as the Commission has already recognized that such technologies can facilitate co-existence among terrestrial wireless operations, says ViaSat, these same technologies can also be employed to enable coordination with satellite earth stations in those terrestrial bands.<sup>292</sup>

152. Under the SAS option, we propose to require terrestrial licensees to provide satellite operators with essential information that the satellite operators will need in order to avoid causing interference to terrestrial operations. We propose to require licensees to provide a SAS provider with the geographic coordinates and other pertinent technical information for their links. We seek comment on what information, under this scenario, should be provided to the SAS operator. For stationary operations, we anticipate that the technical parameters that will be useful to FSS operators seeking to avoid causing interference will resemble, or perhaps be a subset of, the technical parameters that we require Fixed Service point-to-point license applicants to submit on Form 601, Exhibits D, H, and I, or their electronic equivalents. It is not yet possible to delineate a similarly specific set of parameters for mmW mobile base stations and user equipment because the design features of such equipment are still under development. Since Form 601 has been designed in part to accommodate applications for point-to-multipoint licenses, however, many of the parameters required by that form could also be pertinent to mmW mobile base stations, most of which will likely provide omnidirectional service over limited areas.

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<sup>287</sup> *3.5 GHz Report and Order*.

<sup>288</sup> *3.5 GHz Report and Order*, 30 FCC Rcd at 3959 ¶ 2.

<sup>289</sup> T-Mobile Comments at 8, WIF Comments at 4, Google Comments at 5-6, ViaSat Reply Comments at 8.

<sup>290</sup> ViaSat Comments at 9.

<sup>291</sup> ViaSat Comments at 9-10.

<sup>292</sup> ViaSat Comments at 10.

153. We recognize that, under most circumstances, the Commission's existing rules do not require the licensees of geographic service areas to file or otherwise publish the locations and technical characteristics of their individual transmitters and receivers. In this case, the benefits of enhanced sharing of the spectrum may outweigh any burden on the Upper Microwave Flexible Use Service licensee. We also note that existing licensees would obtain substantial benefits as a result of our proposed actions, including mobile operating rights. To avoid burdening terrestrial licensees prematurely or unnecessarily with this reporting requirement, we propose to defer implementing it until an FSS operator notifies the Upper Microwave Flexible Use Service licensee that it will soon begin deploying user equipment in the licensee's geographic service area or other area of operation. We also propose to require satellite operators to bear the cost of operating the SAS, for two reasons. First, the user equipment transmissions of satellite operators would be secondary to terrestrial operations in the 27.5-28.35 GHz band, and it is their responsibility to avoid causing interference to primary users. Second, we assume that the SAS operators have the ability to pass along their costs of operation to their subscribers, with a reasonable profit margin, and that the SASs' internal costs will depend upon the complexity of coordination requested by the satellite operators. We seek comment on these proposals.

**b. Beacon Signaling**

154. Another option for facilitating FSS deployment of fixed user equipment on a secondary basis is to require Upper Microwave Flexible Use Service base stations to transmit beacon signals to assist satellite earth stations in determining the presence of nearby Upper Microwave Flexible Use Service links or base stations and the likely presence of user terminals communicating with those base stations. The beacon signals could either be separate signals or components of the forward-link signals that fixed links or base stations transmit to the user terminals with which they are communicating, similar to the pilot signals transmitted by CDMA and LTE base stations. Such beacon signals could be particularly helpful if they were modulated with messages containing some parameters describing the base stations' characteristics, *e.g.*, geographic location, coverage radius, height above average terrain, and antenna characteristics. Satellite earth stations would be required to monitor those beacon signals and have geolocation capability to determine keep-quiet areas, based on knowledge of their own signal characteristics and information about nearby Upper Microwave Flexible Use Service stations provided by their beacon signals.

155. We seek comment on the feasibility and desirability of this alternative approach. Would it be technically and economically feasible for 28 GHz Upper Microwave Flexible Use Service licensees to provide, and for FSS operators to use, the information provided by a beacon signal? Would this approach be more or less burdensome for Upper Microwave Flexible Use Service licensees than establishing an SAS? Is there a risk that transmitting a beacon signal could cause interference in its own right? Finally, how burdensome to require 28 GHz terrestrial licensees to provide technical information on their stations' characteristics concurrently via an SAS and by signal beacons, and would such requirements provide any added assurance that FSS stations would not interfere with terrestrial operations?

**c. Limiting Satellite or Terrestrial Operations**

156. Another possible means of facilitating sharing would be to modify existing limits on FSS transmissions toward the horizon below a specified elevation angle, but require Upper Microwave Flexible Use Service licensees to be capable of screening out incoming signals above the same elevation angle or another complementary angle.<sup>293</sup> Last year, the Commission was able to facilitate spectrum sharing between satellite and Wi-Fi operations in the 5.15-5.25 GHz band by limiting the output power of Wi-Fi transmissions at elevations above 30 degrees, even though, in the same order, it authorized increased power for Wi-Fi transmitters at lower elevation angles and allowed them to be operated

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<sup>293</sup> Section 25.204 contains existing limits on satellite earth station transmissions toward the horizon at elevation angles below 5°.

outdoors in a band where they had previously been restricted to indoor-only operation.<sup>294</sup> In the 28 GHz band, the predominant source of interference would be Earth-to-space transmissions by FSS earth stations, but a similar kind of angular separation could potentially be applied by limiting the power of their transmissions below a specified angle. By one account, most industry evaluations of potential mmW mobile station deployments assume that such stations' antennas will be tilted downward by 6 to 15 degrees, a configuration that would presumably limit base stations' vulnerability to incoming interference.<sup>295</sup> To what extent could angular separation protect the mobile user equipment that communicates with those base stations? To what extent could angular separation protect fixed backhaul, since point-to-point links may require a variety of elevation angles?

#### d. Active Signal Cancelling

157. Satellite operators already make use of signal cancelling technology to transmit and receive simultaneously on the same channels,<sup>296</sup> and intensive research and development is underway to apply similar techniques to terrestrial communications.<sup>297</sup> We seek comment on the possibility that active signal cancellation could be used to limit the extent of interference between satellite and terrestrial operations. One possible means of implementing this approach might be to require FSS operators to provide Upper Microwave Flexible Use Service licensees with information on the content or format of their uplink transmissions, sufficient to provide terrestrial operators with the ability to generate countervailing suppression signals.

158. Is such a concept feasible and workable? Since FSS user equipment transmissions would be secondary in the band, would it be reasonable to require Upper Microwave Flexible Use Service licensees to generate countervailing suppression signals? How would those burdens compare to the other benefits they would be receiving if the Commission upgrades their licenses to allow mobile operations?

#### e. Movable FSS User Equipment

159. The initial phase of this docket will focus on opportunities for secondary use of FSS user equipment at fixed locations. We also note, however, that the Commission has previously adopted regulations authorizing the provision of FSS to moving platforms in other bands, with respect to vehicle-mounted earth stations (VMESs),<sup>298</sup> earth stations on vessels (ESVs),<sup>299</sup> and earth stations aboard aircraft (ESAAs).<sup>300</sup> We do not presume that satellite operators will choose to deploy user equipment on moving

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<sup>294</sup> See In the Matter of Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band, *First Report and Order*, 29 FCC Rcd 4127 (2014).

<sup>295</sup> See Young-Han Nam, et al., of Samsung Telecommunications America, *Full-Dimension MIMO (FD-MIMO) for Next Generation Cellular Technology*, IEEE Communications Magazine, June 2013, 172 at 174.

<sup>296</sup> See DoubleTalk®Carrier-in-Carrier® Bandwidth Compression, <http://www.comtechedata.com/technologies/doubletalk>.

<sup>297</sup> See Steven Hong et al., *Applications of Self-Interference Cancellation in 5G and Beyond*, IEEE Communications Magazine, February 2014, at 114 *et seq.*

<sup>298</sup> See 47 C.F.R. § 25.226; Amendment of Parts 2 and 25 of the Commission's Rules to Allocate Spectrum and Adopt Service Rules and Procedures to Govern the Use of Vehicle-Mounted Earth Stations in Certain Frequency Bands Allocated to the Fixed-Satellite Service, IB Docket No. 07-101, *Report and Order*, 24 FCC Rcd 10414, 10424 ¶ 31 (2009) ("*VMES Report and Order*"), *recon.*, 28 FCC Rcd 488 (2013) ("*VMES Reconsideration Order*").

<sup>299</sup> See 47 C.F.R. § 25.221; In the Matter of Procedures to Govern the Use of Satellite Earth Stations on Board Vessels, *Report and Order*, 20 FCC Rcd 674, 683-684 ¶ 16 (2005) ("*ESV Order*"), *recon.*, 24 FCC Rcd 10369 (2009), *further recon.*, 27 FCC Rcd 8555 (2012).

<sup>300</sup> See 47 C.F.R. § 25.227. In the Matter of Revisions of Parts 2 and 25 of the Commission's Rules to Govern the Use of Earth Stations Aboard Aircraft Communicating with Fixed-Satellite Service Geostationary-Orbit Space

(continued....)

platforms in the 28 GHz band, but we also believe that evolving technology and market conditions should be the gating mechanisms for any such initiatives, not regulatory proceedings. We propose to adapt our existing rules for FSS to moving platforms and apply them to the 28 GHz band. All of those rules require satellite user equipment to mute their signals instantaneously whenever they lose location awareness or signal lock with their serving satellites, in part to avoid causing interference to other satellites.<sup>301</sup> Because those satellites are typically spaced at two degree intervals along the geostationary arc or, in the case of NGSO satellites, are moving rapidly overhead from one horizon to another, the rules for FSS on moving platforms require extreme precision and reliability. We expect to initiate further proceedings to address satellite operations on movable platforms, either in another phase of this proceeding or in a separate docket that addresses movable FSS satellite equipment in multiple bands. We invite comments to guide our deliberations in developing those provisions.

#### 4. 37.5-40 GHz Band Sharing Issues

160. We seek comment on three issues relating to FSS use of the 37.5-40 GHz band. First, we seek comment on whether we should make any changes to our treatment of gateway earth station applications in this band. Second, we seek comment on whether it would be reasonable to eliminate the prohibition against ubiquitous deployment of space-to-Earth user equipment in that band. Third, we seek further comment on allowing satellite operators in this band to increase the intensity of their PFDs above existing limits during heavy rain storms, subject to the provisions discussed below.

161. Unlike in the 28 GHz band, FSS earth stations in the 37.5-40 GHz band are primary in the Table of Allocations.<sup>302</sup> Under our rules, however, gateway earth stations may only be deployed if the FSS licensee obtains a 39 GHz license in the area where the earth station will be located, or if it enters into an agreement with the corresponding 39 GHz licensee.<sup>303</sup> We seek comment on whether we need to update this rule to reflect the Upper Microwave Flexible Use Service we are proposing today. Are there any other changes we should consider to this rule?

162. In the 28 GHz band, we are seeking comment on establishing a waiver process by which non-Federal FSS earth stations could acquire co-primary status in those areas where there is no LMDS licensee if they can demonstrate that they would not have a negative impact on future terrestrial service.<sup>304</sup> We seek comment on establishing a similar waiver process for non-Federal FSS earth stations in the 37.5-40 GHz band.<sup>305</sup> Does the fact that this band is space-to-Earth require any changes to the proposed waiver process?

163. With regard to reception of space-to-Earth signals by user equipment in this band, ViaSat argues that opportunistic access to this spectrum would be useful and appropriate for satellite operators, provided that they also have reliable access to a base of spectrum in other bands that are dedicated to satellite operations on a primary basis, where satellites will always be able to operate on an unimpeded basis.<sup>306</sup> Do other parties see potential value in this possible opportunistic use? We seek comment on whether the concepts that we have discussed with respect to fixed satellite user equipment in the 28 GHz

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Stations Operating in the 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz and 14.0-14.5 GHz Frequency Bands, *Second Report and Order on Reconsideration*, 29 FCC Rcd 4226 (2014).

<sup>301</sup> See 47 C.F.R. §§ 25.222, 25.226, 25.227.

<sup>302</sup> See 47 C.F.R. § 2.106, United States Table of Allocations.

<sup>303</sup> See 47 C.F.R. § 25.202(a)(1) n.3.

<sup>304</sup> See Section IV.C.2.a, *supra*.

<sup>305</sup> Since there are no current non-Federal FSS licensees in the 37.5-40 GHz band, we need not address the question of how to treat current licensees.

<sup>306</sup> See ViaSat Comments at ii and 8.

band could be applied to the 37.5-40 GHz band with respect to non-Federal FSS users. Should we require satellite operators to demonstrate that they will have access to such dedicated spectrum before they begin space-to-Earth operations in the 37.5-40 GHz band on an opportunistic basis? Would such a requirement help prevent disruptions to consumers when deployment of nearby terrestrial service would preclude continued reception of satellite signals in the 37.5-40 GHz band? If the non-Federal satellite service provider has complementary access to core spectrum that is dedicated to satellite operations, the consumer in this scenario would at worst suffer a reduction in transmission speeds. Does the potential availability of terrestrial service alternatives under these circumstances suggest that it will not be necessary to require non-Federal satellite operators to have complementary access to primary satellite spectrum?

164. As in the 27.5-28.35 GHz band, we seek comment on authorizing the provision of stationary non-Federal FSS user equipment in the 37.5-40 GHz band, as we propose to adopt service rules authorizing terrestrial mmW mobile operations in this band. While satellite user equipment will not be transmitting Earth-to-space signals in this band and, thus, will not cause interference to terrestrial operations, we believe providing their operators with information about terrestrial stations is required in order for those operators to adapt their user equipment deployment plans to take into consideration the presence of interference generated by terrestrial stations. We invite comments on our proposal and alternatives with respect to this band.

165. Finally, we invite comments on the terms and conditions under which satellite operators should be allowed to increase their PFDs in the 37.5-40 GHz band to overcome rain-fade conditions, as the Commission proposed earlier in the *V-Band Third FNPRM*.<sup>307</sup> Specifically, we seek to refresh the record to reflect advances in signal processing and information processing systems that have occurred during the five years since the *V-Band Third FNPRM* was issued. In particular, we invite commenters to propose means by which satellite operators might be able to discern the conditions under which terrestrial operations would be shielded by the same rain storms that are affecting satellite earth stations and, thus, would not necessarily experience interference if a satellite operator were to raise its PFD. We also seek to identify means by which satellite operators could discern when the affected terrestrial operators would not be shielded from increased satellite PFD and would experience elevated levels of interference. Could satellite operators use weather radar data to determine when satellite PFD adjustments are needed and when terrestrial systems would also be affected by rain fade? Is there commercially available equipment that would enable terrestrial operators to determine when they are experiencing elevated levels of interference from satellite signals, and to differentiate that source of interference from the rain-fade conditions that might be causing nearby satellite earth stations to request increased PFD from the satellite? If so, we request comment on the feasibility of establishing automatic, real-time linkages between satellite and terrestrial operators so that their equipment can coordinate their strategies to overcome interference from natural causes and from each other.

#### **D. Federal Sharing Issues**

166. Portions of the 39 GHz and 37 GHz bands are shared with the Federal government. In addition, there are passive Federal and non-Federal allocations below 37 GHz that need to be considered when developing service rules for the 37 GHz band. Through the inter-agency process, we will continue work with NTIA and the Federal agencies to update the information on current and future Federal use of the 37 GHz band, provide the appropriate technical parameters for envisioned fixed and mobile applications, assess sharing compatibility, and establish sharing arrangements to enable the development of service rules for innovative commercial wireless services. Below, we describe the relevant Federal allocations, provide the available information we have, and raise pertinent questions concerning sharing between Federal and non-Federal operations where appropriate.

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<sup>307</sup> See *V-Band Third FNPRM*, 25 FCC Rcd at 15674-15683 ¶¶ 30-55.

167. In addition, we seek comment on whether the future mmW technologies might be able to support a platform that could enable expanded sharing, including two-way shared use between Federal and non-Federal users in these bands and sharing among different types of service platforms. For instance, could the future mmW technology be used to support convergence of historically different network topologies beyond just mobile, fixed, and satellite, to include air-to-ground or ground-to-air, high altitude uses, or others uses? Could the same benefits of mmW technology that help facilitate different users and use cases also support increased sharing between Federal and non-Federal uses in the non-Federal portions of these bands?

### 1. 39.5-40 GHz

168. There is a Federal allocation for FSS (space-to-Earth) and MSS (space-to-Earth) in the 39.5-40 GHz band. Federal government earth stations in the MSS in the 39.5-40 GHz band are prohibited from claiming protection from non-Federal stations in the Fixed and Mobile Services in this band, but are not required to protect non-federal Fixed and Mobile Services in the band (*i.e.*, 5.43A of the ITU Radio regulations does not apply).<sup>308</sup> This prohibition does not apply to Federal government earth stations in the FSS. When the *39 GHz Report and Order* was adopted, Federal government use of the band was limited to military systems in the 39.5-40 GHz band segment, but the Department of Defense stated that it had plans to implement satellite downlinks at 39.5-40 GHz in the future, and the National Aeronautics and Space Administration (NASA) identified 39.5-40 GHz as a possible space research band to accommodate future Earth-to-space wideband data requirements.<sup>309</sup> The *39 GHz Report and Order* expressed optimism that such plans would not affect the continued development of the 39 GHz band for non-Government use, but the Commission said that it intended to address those interference issues in a future, separate proceeding that would focus on developing inter-licensee and inter-service standards and criteria.<sup>310</sup> At present, the U.S. Table of Frequency Allocations provides that Federal satellite services in the 39.5-40 GHz band are limited to military systems.<sup>311</sup>

169. We seek comment on whether the existing allocation provisions are sufficient to ensure coexistence between Federal and non-Federal operations. We seek comment on appropriate protections for Federal operations in the 39.5-40 GHz band. What considerations should we keep in mind as we develop service rules for the 37.5-40 GHz band? What are the appropriate principles and mechanisms we should use to ensure protection of Federal operations and coexistence with commercial operations? Are any limitations or special rules on mobile use necessary in order to protect Federal military FSS use of the 39.5-40 GHz band? Are there any additional measures needed in terms of Out-of-Band (OOBE) limits that are needed to protect federal MSS and FSS downlink operations in the adjacent 40-40.5 GHz band?

### 2. 37-38.6 GHz

170. There is also an allocation for federal space research, fixed, and mobile service operations in the 37-38 GHz band. There are also federal fixed and mobile allocations in the 38-38.6 GHz band. In 2004, NTIA sent a letter to the Commission identifying the following NASA receiving earth stations in the SRS in the 37-38 GHz band: Goldstone, California; Guam, Pacific Ocean; Merritt Island, Florida; Wallops Island, Virginia; and White Sands, New Mexico.<sup>312</sup> NTIA has subsequently identified the NASA receiving earth station at Blossom Point, Maryland. NTIA also identified Green Bank, Virginia; and Socorro, New Mexico NSF sites to support their Very Long Baseline Interferometry

<sup>308</sup> See Table of Frequency Allocations, 47 C.F.R. § 2.106 n.US382.

<sup>309</sup> *39 GHz R&O*, 12 FCC Rcd at 18615 ¶ 25.

<sup>310</sup> *39 GHz R&O*, 12 FCC Rcd at 18615 ¶ 25.

<sup>311</sup> 47 C.F.R. § 2.106, Table of Frequency Allocations, Federal Government n.G117.

<sup>312</sup> See letter from Fredrick R. Wentland, Associate Administrator, Office of Spectrum Management, NTIA, dated March 24, 2004, to Mr. Edmond J. Thomas, Chief, Office of Engineering and Technology, FCC.

(VLBI) earth station operations. NTIA noted the importance of the 37-38 GHz band to support U. S. goals to provide a permanent manned presence in Earth orbit (on or near the moon), to initiate manned exploration of the planet Mars, and to support VLBI by satellite.

171. In their 2004 letter, NTIA also identified 14 military sites in the 37-38.6 GHz band that required protection. NTIA recommended that coordination with the federal operations be performed within the IRAC process. In 2006, NTIA sent a follow-up letter to the FCC reaffirming the need to protect NASA, NSF, and military operations from non-federal terrestrial and FSS operations in the 37-38 GHz band.<sup>313</sup> NTIA requested that the protection of federal operations be accomplished by establishing a footnote to the U.S. Table of Frequency allocations specifying the federal sites and the coordination areas. NTIA also recommended that because of the potential interference from airborne systems, the aeronautical Mobile Service allocation should be deleted from the band 37-38 GHz.

172. We seek comment on appropriate protections for Federal operations in the 37 GHz band. What considerations should we keep in mind as we develop service rules for the 37 GHz band? What are the appropriate principles and mechanisms we should use to ensure protection of Federal operations and coexistence with commercial operations?

### 3. Passive Services Below 37 GHz

173. There are Federal and non-Federal allocations for the EESS (passive) and SRS (passive) in the 36-37 GHz band. Those services shall not receive protection from fixed and mobile allocations operating in accordance with the U.S. Table of Allocations.<sup>314</sup> The 36.43-36.5 GHz band is used for radio astronomy spectral line emissions, and as specified in footnote US342 all practicable steps must be taken to protect radio astronomy in that band from interference.<sup>315</sup> There are several allocations around 40 GHz to the radio astronomy service for both continuum and spectral line observations, some through footnote protections. Some of these allocations are shared with different types of active services. Pertinent to the bands under consideration and bands near 40 GHz covered under US342, there are Very Large Array receivers in current operation that observe the cosmos over the nominal frequency ranges of 26.5-40 GHz (Ka-band), and 40-50 GHz (Q-band). VLBA receivers cover 21.7-24.1 GHz and 41.0-45.0 GHz. Similarly, the Green Bank Telescope has a sensitive receiver and specialized wideband (continuum as well as spectrometric) back-ends for observations over the 26-40 GHz range.

174. CORF reports that the 36-37 GHz band is used by a series of instruments that provide data on ocean winds, cloud liquid water, precipitation, terrestrial snow, sea ice cover, and sea surface temperature.<sup>316</sup> CORF explains that most of these instruments operate in a direct detection mode, which means that their ability to reject out-of-band emissions is limited.<sup>317</sup> CORF states that these instruments are particularly susceptible to interference because they operate in lower orbits and have larger receiver antennas.<sup>318</sup> According to CORF, a single one watt isotropic radiator at 37 GHz would need to be rejected at greater than 36 dB to not be seen by these instruments, and 1,000 mobile devices operating in

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<sup>313</sup> See letter from Fredrick R. Wentland, Associate Administrator, Office of Spectrum Management, NTIA, dated Sept. 13, 2006, to Mr. Julius Knapp, Chief, Office of Engineering and Technology, FCC.

<sup>314</sup> United States Table of Allocations, 47 C.F.R. § 2.106 n.US263.

<sup>315</sup> United States Table of Allocations, 47 C.F.R. § 2.106 n.US342.

<sup>316</sup> CORF Comments at 8. Those instruments include the NASA Global Precipitation Measurement Mission's Microwave Imager, NASA Tropical Rainfall Measuring Mission's Microwave Imager, DoD Special Sensor Microwave/Imager and WindSat instruments, and the JAXA Global Change Observation Mission-Water 1's Advanced Microwave Scanning Radiometer 2. *See id.*

<sup>317</sup> CORF Comments at 5.

<sup>318</sup> CORF Comments at 9.

that band would need to be rejected by greater than 66 dB.<sup>319</sup> CORF asks for unspecified guard bands to protect EESS operations.<sup>320</sup>

175. Whenever possible, the radio astronomy community takes a number of measures to mitigate the impacts of interference, including locating radio observatories in remote areas and by using bands allocated or footnote-protected for radio astronomy services. Spectrum management and regulatory processes are, therefore, critical for interference-free radio astronomical operations. The provisions of US342 and ITU-R No. 5.149, for instance, have provided local protection for radio observatories. The FCC will continue to work closely with NTIA and NSF to help facilitate mobile applications in the mmW bands, while mitigating the impacts on existing radio astronomy facilities.

176. We seek comment whether any special protections are necessary or appropriate for passive services below 37 GHz. As noted, EESS and space research operations are not entitled to interference protection from duly authorized Fixed and Mobile Services. Nonetheless, we seek comment on whether there are steps we could take to protect those operations without unduly limiting fixed and mobile operations in the 37 GHz band. For example, would setting the lower edge of the 37 GHz band at 37.1 GHz, thus creating a 100 megahertz guard band, be helpful? Is it practical to establish a stricter out-of-band emission limit at the lower edge of the 37 GHz band? We also seek comment on whether any special protections are needed to protect radio astronomy operations in the 36.43-36.5 GHz band, which is entitled to interference protection.

## **E. Licensing, Operating, and Regulatory Issues**

### **1. Creation of New Rule Service and Part**

177. LMDS and the 39 GHz service are currently regulated under Part 101 of the Commission's rules, which governs fixed microwave services. In light of the additional flexibility we are providing to LMDS and 39 GHz licensees, including mobile operating rights, we propose to create a new radio service, the Upper Microwave Flexible Use Service, and regulate that new service under a new Part 30 of the Commission's rules. We also propose to include the contemplated new 37 GHz band as part of the Upper Microwave Flexible Use Service. We seek comment on these proposals.

178. We believe establishing a new rule part for these services would allow us to have one unified set of rules governing the various types of operations we contemplate licensees will offer. While there may be administrative advantages to keeping LMDS and the 39 GHz service in Part 101, we believe establishing a new rule part would provide more clarity and more accurately reflect the nature of these licenses. We ask commenters to offer their views. Is a new rule part appropriate? Should the services remain in Part 101? Alternatively, would placing these services in Part 27 of the Commission's rules be an option?

### **2. Regulatory Status**

179. *Background.* For LMDS, the Commission has previously determined that applicants could provide common-carrier service, non-common carrier service, or both, and also enabled licensees to later amend their applications or modify that status.<sup>321</sup> The Commission permitted LMDS to be licensed to allow both common carrier and non-common carrier services in a single license.<sup>322</sup> In other words, the Commission permitted LMDS licensees to provide all services anywhere within its licensed area at any time, consistent with the statutory and regulatory requirements that are imposed on the respective

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<sup>319</sup> CORF Comments at 9.

<sup>320</sup> CORF Comments at 9.

<sup>321</sup> *Second LMDS Report and Order*, 12 FCC Rcd at 12643-12645, 12652-54 ¶¶ 221-226, 245-251.

<sup>322</sup> *Id.* at 12651 ¶ 244.

operations.<sup>323</sup> In adopting this rule, the Commission expressly rejected the application of a presumption of common carrier status to an application.<sup>324</sup>

180. Similarly, in the 39 GHz band, the Commission concluded that licensees should be permitted to serve as a common carrier or as a private licensee.<sup>325</sup> It determined that, for those licensees who select common-carrier regulatory status, they would be able to provide private service, and those licensees who select private service provider regulatory status could share the use of their facilities on a non-profit basis or could offer service on a for-profit, private carrier basis, subject to section 101.135 of the Commission's rules.<sup>326</sup> Under this approach, licensees would elect the status of the services they wish to offer and be governed by the rules applicable to their status.<sup>327</sup>

181. The open and flexible approach the Commission took to regulatory status in Part 101 is also consistent with the Commission's approach to other wireless services, such as the Part 27 rules for terrestrial wireless service. The Commission permits Part 27 applicants who may wish to provide both common carrier and non-common carrier services (or to switch between them) under a single license to request status as both a common carrier and a non-common carrier.<sup>328</sup> Such licensees are able to provide all allowable services anywhere within their licensed area at any time, consistent with their regulatory status. Applicants are required to indicate regulatory status for any services they choose to provide, but apart from that designation, they are not generally required to describe the services they seek to provide.<sup>329</sup> Further, licensees must notify the Commission if they change the service or services they offer such that it would be inconsistent with their regulatory status.<sup>330</sup>

182. *Discussion.* We propose to maintain the open and flexible regulatory framework for the Upper Microwave Flexible Use Service. Specifically, we propose to permit the full array of Fixed and Mobile Service offerings without undue regulatory restraint. In doing so, our goal is to maintain an open and flexible approach that will allow the business judgments of individual applicants and licensees in these bands to shape the nature of the services offered pursuant to their licenses.

<sup>323</sup> *Id.* at 12643-12644 ¶ 222.

<sup>324</sup> *Id.* at 12643 ¶ 222. The Commission did specify that “[a]n LMDS licensee may be required to adhere to the following filing or authorization requirements in modifying a station: (1) in Section 1.1301 through 1.1319 concerning actions that may have a significant impact on the quality of the human environment, (2) in Sections 22.369 and 101.123 concerning radio frequency quiet zones, (3) Part 17 of our rules concerning antenna structure clearance procedures and the obligation under Section 17.4 to register with the Commission prior to construction, (4) any restrictions regarding border areas under international agreements, and (5) any applicable technical rules in this part.” *Id.* at 12643-12644 ¶ 222.

<sup>325</sup> *39 GHz R&O*, 12 FCC Rcd at 18635 ¶ 76.

<sup>326</sup> *Id.*

<sup>327</sup> *Id.*

<sup>328</sup> See 47 C.F.R. § 27.10; Amendment of the Commission's Rules to Establish Part 27, the Wireless Communications Service (“WCS”), GN Docket No. 96-228, *Report and Order*, 12 FCC Rcd 10785 at 10846-48 ¶¶ 119-122 (1997) (“*Part 27 Report and Order*”).

<sup>329</sup> See *Part 27 Report and Order*, 12 FCC Rcd at 10848 ¶ 121; see also *LMDS Second Report and Order*, 12 FCC Rcd at 12644 ¶ 223; 47 C.F.R. § 101.1013.

<sup>330</sup> See 47 C.F.R. § 27.10(d), see also 47 C.F.R. § 27.66. A change in an AWS licensee's regulatory status does not generally require prior Commission authorization, provided the licensee was in compliance with the foreign ownership requirements of section 310(b) of the Communications Act that would apply as a result of the change. 47 U.S.C. § 310(b); see *infra* at ¶¶ 185-188. Under Part 27, licensees are generally required to file the notification within 30 days of a change made without the need for prior Commission approval, except that a different time period may apply where the change results in the discontinuance, reduction, or impairment of the existing service. See 47 C.F.R. § 27.66.

183. We propose to permit applicants and licensees to request common carrier status, non-common carrier status, private internal communications status, or a combination of these options, for authorization in a single license (or to switch between them).<sup>331</sup> Applicants in these bands therefore would be able to, but would not be required to, choose between providing common carrier and non-common carrier services. If an applicant requested both common carrier and non-common carrier status in the same application, it would result in the issuance of both authorizations in a single license. Alternatively, the applicant may wish to limit its operations to common carrier or non-common services, in which case it would apply only for authorization on a common carrier or a non-common carrier basis, and the license would be issued for the status specified. The licensee would be able to provide all Fixed and Mobile Services anywhere within its licensed area at any time (except for indoor operating rights in the 37 GHz service),<sup>332</sup> consistent with the statutory and regulatory requirements that are imposed on its respective operations. We note that it would be the licensee's obligation to maintain the various operations in compliance with all those requirements.

184. We observe that an applicant is to rely on the realities of the services to be provided in electing the appropriate regulatory status. An election to provide service on a common carrier basis requires that the elements of common carriage be present; otherwise, the service is non-common carriage. Consistent with this approach, we propose to rely on the designation by an applicant of its status as a common carrier or non-common carrier, consistent with the Commission's decisions regarding the regulatory classification of mobile services,<sup>333</sup> to enable us to fulfill our obligations to enforce the common carrier requirements contained in statutes and our regulations. We seek comment on this proposal.

### 3. Foreign Ownership Reporting

185. *Background.* Certain foreign ownership and citizenship requirements are imposed by subsections (a) and (b) of Section 310 of the Act, as modified by the 1996 Act.<sup>334</sup> These provisions prohibit the issuance of licenses to certain applicants. For current LMDS, 37 GHz, and 39 GHz licensees, these statutory provisions are adopted in Part 101 of the Commission's rules at section 101.7 of the Commission's rules.<sup>335</sup> Specifically, section 101.7(a) prohibits the granting of any license to be held by a foreign government or its representative.<sup>336</sup> Section 101.7(b) prohibits the granting of any common carrier license to be held by individuals that fail any of the four citizenship requirements listed.<sup>337</sup>

186. *Discussion.* We tentatively conclude that these Section 310 requirements would apply to any applicants in the Upper Microwave Flexible Use Service. An applicant requesting authorization only for broadcast, common carrier, aeronautical en route, or aeronautical Fixed Services would be prohibited from holding a license if it met any of the criteria in subsection (b). If the applicant requested authorization for services other than for broadcast, common carrier, aeronautical en route, or aeronautical Fixed Services, it could hold a license if it met the single alien ownership requirement in Section 310(a), regardless of whether it would otherwise be disqualified for a common carrier authorization. And if the

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<sup>331</sup> See 47 C.F.R. § 27.10; Amendment of the Commission's Rules to Establish Part 27, The Wireless Communications Service ("WCS"), 12 FCC Rcd 10785, 10846-10848 ¶¶ 119-122 (1997) (*Part 27 Report and Order*).

<sup>332</sup> See *supra* Section IV.B.2.

<sup>333</sup> See, e.g., Protecting and Promoting the Open Internet, GN Docket No. 14-28, *Report and Order on Remand, Declaratory Ruling, and Order*, 30 FCC Rcd 5601, 5743-5744 ¶ 331 (2015).

<sup>334</sup> 47 U.S.C. § 310.

<sup>335</sup> 47 C.F.R. § 101.7.

<sup>336</sup> *Id.*

<sup>337</sup> *Id.*

applicant requested authorization for both non-common carrier and common carrier services, it would be disqualified from a license if it met any of the criteria in Section 310(b). Whether the applicant is seeking only common carrier authorization in a license or in combination with a non-common carrier authorization, the provisions of Section 310(b) would apply in either situation and would prevent any common carrier authorization from being issued to an ineligible applicant.

187. We propose that applicants for this band should *not* be subject to different obligations in reporting their foreign ownership based on the type of service authorization requested in the application. Consequently, we propose to require all applicants to provide the same foreign ownership information, which covers both subsections (a) and (b) of Section 310, regardless of which service they propose to provide in the band. We note, however, that we would be unlikely to deny a license to an applicant requesting to provide exclusively services that are not subject to section 310(b), solely because its foreign ownership would disqualify it from receiving a license if the applicant had applied for authority to provide such services. We also note that, if any such licensee later desires to provide any services that are subject to the restrictions in Section 310(b), we would require the licensee to apply to the Commission for an amended license, and we would consider issues related to foreign ownership at that time.

188. Based on the foregoing interpretation of the requirements in Section 310, we propose to apply a new provision in Part 30 that mirrors current section 101.7 of our rules.<sup>338</sup> This approach is also consistent with our treatment of flexible use services regulated under Part 27 of the Commission's rules.<sup>339</sup> We believe that such a provision would properly implement the restrictions contained in Section 310(a) and (b). We request comment on this proposal, including any costs and benefits.

#### 4. Eligibility

189. For the Upper Microwave Flexible Use Service, we propose to adopt an open eligibility standard and seek comment on this approach, including its costs and benefits. In particular, we seek comment on whether adopting an open eligibility standard for the licensing of these bands would encourage efforts to develop new technologies, products, and services, while helping to ensure efficient use of this spectrum. We note that an open eligibility approach would not affect citizenship, character, or other generally applicable qualifications that may apply under our rules.

#### 5. Mobile Spectrum Holdings Policies

190. Spectrum is an essential input for the provision of mobile wireless services, and ensuring access to and the availability of sufficient spectrum is crucial to promoting the competition that drives innovation and investment.<sup>340</sup> The Commission has held that the Communications Act requires a close examination of the impact of spectrum aggregation on competition, innovation, and the efficient use of spectrum to ensure that spectrum is allocated and assigned in a manner that serves the public interest, convenience and necessity, and avoids the excessive concentration of licenses.<sup>341</sup> In May 2014, the Commission adopted the *Mobile Spectrum Holdings R&O*, which revised its mobile spectrum holding policies.<sup>342</sup> The Commission determined, among other things, to replace its post-auction case-by-case analysis of the licensing of spectrum bands through competitive bidding with a determination of whether

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<sup>338</sup> 47 C.F.R. § 101.7.

<sup>339</sup> See 47 C.F.R. § 27.12(a).

<sup>340</sup> See generally *Seventeenth Mobile Wireless Competition Report*, 29 FCC Rcd 15311, 15316 (2014); See Policies Regarding Mobile Spectrum Holdings; Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, WT Docket No. 12-269, GN Docket No. 12-268, *Report and Order*, 29 FCC Rcd 6133, 6167 ¶ 67 (2014) ("*Mobile Spectrum Holdings R&O*").

<sup>341</sup> See *Mobile Spectrum Holdings R&O*, 29 FCC Rcd at 6136 ¶ 6, 6167-6168 ¶ 67; 47 U.S.C. § 309(j)(3); 47 U.S.C. § 310(d).

<sup>342</sup> See generally *Mobile Spectrum Holdings R&O*, *supra*.

a band-specific mobile spectrum holding limit is necessary and, if so, to establish that limit *ex ante*.<sup>343</sup> The Commission further determined to continue to use its initial spectrum screen and case-by-case review for proposed secondary market transactions.<sup>344</sup>

191. We seek comment generally on how to address any mobile spectrum holdings issues involving the bands proposed for the new radio service in order to meet our statutory requirements and our goals for these bands.<sup>345</sup> As discussed below, we are proposing to resolve all applications and license assignments in areas where there is currently no fixed licensee through competitive bidding.<sup>346</sup> In considering whether to adopt a mobile spectrum holdings limit for the licensing of a particular band through competitive bidding, as well as what type of limit to apply, the Commission concluded in the *Mobile Spectrum Holdings R&O* that it will assess whether the acquisition at auction of licenses to use a significant portion of spectrum by one or more providers could potentially harm the public interest by reducing the likelihood that multiple service providers would have access to sufficient spectrum to compete robustly.<sup>347</sup> The Commission indicated that this determination will be based on several factors, including total amount of spectrum to be assigned, characteristics of the spectrum to be assigned, timing of when the spectrum could be used, and the specific rights being granted to licensees of the spectrum.<sup>348</sup> The Commission indicated that the determination also will be based on the extent to which competitors have opportunities to gain access to alternative bands that would serve the same purpose as the spectrum licenses at issue.<sup>349</sup> We seek comment on whether to adopt a band-specific spectrum holding limit in the licensing of these spectrum bands through competitive bidding, either for individual bands or a combination of these bands, and ask commenters to consider the costs and benefits of any such limits.

192. In addition to considering whether to adopt a band-specific limit on the aggregation of these spectrum bands, we also will consider whether these bands are suitable and available for the provision of mobile telephony/broadband services in the same manner as other spectrum bands that currently are included in the Commission's spectrum screen as applied to secondary market transactions.<sup>350</sup> We seek comment on our proposed approach not to include these bands in the spectrum screen. Similar to the determination of whether to adopt a mobile spectrum holdings limit for the licensing of a particular band through competitive bidding, the determination of "suitability" and "availability" in the context of secondary market transactions review involves the evaluation of a number

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<sup>343</sup> See *Mobile Spectrum Holdings R&O*, 29 FCC Rcd at 6192-6193 ¶¶ 139-143.

<sup>344</sup> See *Mobile Spectrum Holdings R&O*, 29 FCC Rcd at 6223-6224 ¶ 231.

<sup>345</sup> See, e.g., Samsung Reply Comments at 5 (stating that "[i]n developing a framework for 5G, the Commission will need to carefully balance the need to provide individual licensees with sufficient contiguous spectrum against the need to promote competition by offering multiple licenses in a market.>").

<sup>346</sup> See Section IV.E.10, *infra*.

<sup>347</sup> See *Mobile Spectrum Holdings R&O*, 29 FCC Rcd at 6193 ¶ 144.

<sup>348</sup> *Id.*

<sup>349</sup> *Id.*

<sup>350</sup> See *Mobile Spectrum Holdings R&O*, 29 FCC Rcd at 6169 ¶ 71. See also *3.5 GHz Report and Order*, 30 FCC Rcd at 3998 n.276 (concluding that the 3.5 GHz band should not be included in the spectrum screen based on the circumstances of that band). Spectrum bands currently included in the spectrum screen are: 700 MHz; cellular; SMR; broadband PCS; H Block at 1915-1920 MHz and 1995-2000 MHz; Advanced Wireless Services (AWS) in the 1710-1755 and 2110-2155 MHz bands (AWS-1, on a market-by-market basis), the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz bands (AWS-3, on a market-by-market basis), and the 2000-2020 MHz and 2180-2200 MHz spectrum bands (AWS-4); Wireless Communications Service (WCS); Broadband Radio Service (BRS, on a market-by-market basis), and Educational Broadband Service (EBS, on a market-by-market basis), as well as 600 MHz at the conclusion of the Incentive Auction). See *Mobile Spectrum Holdings R&O*, 29 FCC Rcd at 6169-6170 ¶¶ 70, 72.

of factors related to the spectrum bands to be held by the acquiring entity.<sup>351</sup> In that regard, we recognize that mmW bands could be particularly useful in supporting very high capacity networks in areas that require such capacity but are likely, given these bands' current technical characteristics, to be used to complement existing lower-band spectrum up through the BRS/EBS band that is currently considered suitable and available for the provision of mobile wireless services.<sup>352</sup> We also recognize the nascent state of mmW technology, as well the early stage of the development of the accompanying standards.<sup>353</sup> In light of these circumstances, it is not clear that, for purposes of including these bands in the spectrum screen applied to secondary market transactions, the bands we propose to license will be "suitable" and "available" spectrum for the provision of mobile telephony/broadband services in the near term.<sup>354</sup> We therefore are disinclined to include these spectrum bands in the spectrum screen and seek comment on this proposed approach.

## 6. Performance Requirements

### a. Introduction

193. The Commission establishes performance requirements to promote the productive use of spectrum, to encourage licensees to provide service to customers in a timely manner, and to promote the provision of innovative services in unserved areas, particularly rural ones. Our overriding purpose in establishing performance requirements is to provide "a clear and expeditious accounting of spectrum use by licensees to ensure that service is indeed being provided to the public."<sup>355</sup> In doing so, we must strike an appropriate balance between providing licensees with operational flexibility and ensuring that spectrum does not lie fallow.

194. Over the years, the Commission has tailored performance requirements with an eye to the unique characteristics of individual frequency bands and the types of services expected, among many other factors. In the case of Part 101 services, such as 24 GHz, LMDS, and 39 GHz, licensees are required to demonstrate that they are providing "substantial service" at the end of their first license period in order to obtain renewal.<sup>356</sup> The Commission has generally defined substantial service as "service

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<sup>351</sup> See *Mobile Spectrum Holdings R&O*, 29 FCC Rcd at 6169 ¶ 71. "Suitability" is determined by whether the spectrum is capable of supporting mobile service given its physical properties and the state of equipment technology, whether the spectrum is licensed with a mobile allocation and corresponding service rules, and whether the spectrum is committed to another use that effectively precludes its uses for mobile services. Spectrum is considered "available" if it is 'fairly certain that it will meet the criteria for suitable spectrum in the near term, an assessment that can be made at the time the spectrum is licensed or at later times after changes in technology or regulation that affect the consideration.'" *Id.*

<sup>352</sup> See *NOI*, 29 FCC Rcd at 13045 ¶ 89 (anticipating, among other things, that base stations in bands above 24 GHz will most likely be integrated into networks that will provide ubiquitous coverage and network coordination in lower bands). See also T-Mobile Comments at 2 (contending generally that the characteristics of this high frequency spectrum make it attractive for addressing network capacity issues in congested areas, but that it would need to be used in combination with lower band spectrum to provide optimum service and coverage to consumers).

<sup>353</sup> See, e.g., O3b Comments at 6 (describing 5G technology as "nascent" and "undefined").

<sup>354</sup> *Mobile Spectrum Holdings R&O*, 29 FCC Rcd at 6169 ¶ 71.

<sup>355</sup> *39 GHz R&O*, 12 FCC Rcd at 18623 ¶ 42. See also Amendment of Part 101 of the Commission's Rules to Facilitate the Use of Microwave for Wireless Backhaul and Other Uses and to Provide Additional Flexibility to Broadcast Auxiliary Service and Operational Fixed Microwave Licensees, WT Docket No. 10-153, *Second Report and Order, Second Further Notice of Proposed Rulemaking, Second Notice of Inquiry, Order on Reconsideration, and Memorandum Opinion and Order*, 27 FCC Rcd 9735, 9772 ¶ 101 (2012) ("*Wireless Backhaul 2nd R&O*").

<sup>356</sup> 47 C.F.R. § 101.1413; *39 GHz R&O*, 12 FCC Rcd at 18623.

which is sound, favorable, and substantially above a level of mediocre service which might minimally warrant renewal.”<sup>357</sup>

195. For Part 101 Fixed Services, including the LMDS and 39 GHz services, the Commission has generally specified safe harbors that will satisfy the substantial service requirement.<sup>358</sup> It has also emphasized that safe harbors are merely one means of demonstrating substantial service, and that given an appropriate showing, a level of service that does not meet a safe harbor may still constitute substantial service.<sup>359</sup> It has also determined that all substantial service showings that do not meet an established safe harbor would be evaluated on a case-by-case basis.<sup>360</sup>

196. In connection with its Wireless Backhaul proceeding, the Commission rejected an argument from the National Spectrum Managers Association (NSMA) that the Commission should credit antecedent activities such as developing equipment, offering spectrum leases, and submitting proposals to potential customers towards a finding of substantial service.<sup>361</sup> The Commission has stated that it would consider possible revisions to buildout policies in upper microwave services in WT Docket No. 10-112.<sup>362</sup>

197. In the *NOI*, we discussed performance requirements in the context of the four mechanisms for licensing vacant spectrum on which we sought comment: 1) licensing exclusive rights to geographic areas, 2) nonexclusive licensing rules using automated frequency coordination, 3) an unlicensed regime under Part 15 of our rules, and 4) a hybrid, spectrum-sharing model.<sup>363</sup> With respect to the first licensing mechanism, we noted that one potential concern with it is that “portions of license areas outside of high-traffic areas could end up lying fallow.”<sup>364</sup> We proposed three different ways we might deal with that concern: 1) relying on secondary market leasing, 2) establishing smaller licensing areas, and 3) adjusting performance requirements to ensure the spectrum is maximally utilized.<sup>365</sup> We noted that there were several ways to pursue this last option, including more objective buildout requirements and an alternative remedy for failure to build out (*e.g.*, keep-what-you-use, which we noted could take several different forms).<sup>366</sup>

198. Several commenters addressed the issue of applying performance requirements in licensing the millimeter wave bands. Qualcomm and Straight Path expressed support for imposing reasonable performance requirements.<sup>367</sup> Other commenters suggested that adjusted performance

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<sup>357</sup> 47 C.F.R. § 101.1413.

<sup>358</sup> *Wireless Backhaul 2nd R&O*, 27 FCC Rcd at 9772 ¶ 101.

<sup>359</sup> *Id.*

<sup>360</sup> *Id.*

<sup>361</sup> Amendment of Part 101 of the Commission's Rules to Facilitate the Use of Microwave for Wireless Backhaul and Other Uses and to Provide Additional Flexibility to Broadcast Auxiliary Service and Operational Fixed Microwave Licensees, WT Docket No. 10-153, *Report and Order, Further Notice of Proposed Rulemaking and Memorandum Opinion and Order*, 26 FCC Rcd 11614, 11661 ¶ 114 (2011).

<sup>362</sup> *Wireless Backhaul 2<sup>nd</sup> R&O*, 27 FCC Rcd at 9773 ¶ 102.

<sup>363</sup> The two unlicensed mechanisms were authorizing non-exclusive licensing rules using automatic frequency coordination, and authorizing mobile operations pursuant to Part 15 of our rules. *NOI*, 29 FCC Rcd at 13047-13048 ¶¶ 100-101.

<sup>364</sup> *Id.* at 13046 ¶¶ 93-95.

<sup>365</sup> *Id.* at 13046 ¶ 95.

<sup>366</sup> *Id.*

<sup>367</sup> Straight Path Comments at 25, Straight Path Reply Comments at 14, Qualcomm Comments at 17, NYU Wireless Comments at 30.

requirements were potential or promising solutions, but stopped short of endorsing them.<sup>368</sup> Other commenters were more skeptical of performance requirements as a tool for ensuring spectrum utilization in these bands, arguing either that traditional performance requirements are: 1) unnecessary if the Commission adopts proper secondary-market policies;<sup>369</sup> or 2) insufficient to ensure spectrum utilization in an exclusive licensing regime based on geographic area.<sup>370</sup> Finally, we note that some of the fixed incumbent licensees argued that buildout requirements for Mobile Services and Fixed Services should be separate so that a failure to meet the mobile requirement would not result in cancellation of the fixed license.<sup>371</sup>

#### **b. Geographic Performance Requirements at the County Level**

199. As discussed elsewhere in this *NPRM*, for the 28 GHz, 39 GHz, and 37 GHz bands, we propose to license each band using county-based licenses. In the 28 GHz and 39 GHz bands, we also propose to assign exclusive rights to geographic areas to existing licensees.<sup>372</sup> In order to make this approach work, we would subdivide existing 28 GHz and 39 GHz licenses on a county basis, where an LMDS or 39 GHz fixed incumbent licensee would give up its existing license and receive new license(s)—containing both fixed and mobile rights—for every county that lay within one of its existing license areas.

200. We propose to apply performance requirements for the Upper Microwave Flexible Use Service at the county level. By proposing to license service areas by county and to measure performance requirements on a county basis, we are providing licensees with flexibility to offer service in counties where the licensee determines it is technologically and economically feasible to do so. A licensee that decides to offer service in such a county would be able to meet the performance requirement and keep its license at the end of its first license term, without needing to provide service in any adjacent counties. Thus, if a licensee held licenses for nearby counties—either because it had obtained them at auction or because it was an existing fixed licensee whose service area had included other counties—and it determined it could not meet the performance requirement in those other counties, those licenses would terminate and go back to the Commission without jeopardizing the licenses in the county where the licensee had built out. Moreover, for licenses in counties where the performance requirement was not met, the Commission would be able to make those licenses available for use by others through re-auction, ensuring that other operators could use the spectrum in those areas.

201. We propose this approach in an effort to foster expeditious deployment by licensees in the 28 GHz, 39 GHz, and 37 GHz bands for the provision of wireless, terrestrial broadband service, and to enable others to have a chance to use the spectrum in areas where such deployment has failed to occur during that time. Because licensees could keep any counties in which they satisfy the performance requirement, and because we are proposing a relatively low population-based benchmark (in comparison to buildout benchmarks we have imposed recently), licensees in these bands would be more likely to build out to actually provide services in areas where it is feasible and less likely to build for the sake of keeping their licenses. At the same time, we believe this scheme still fulfills the basic function of performance requirements in ensuring that spectrum is utilized and spectrum gatekeeping and warehousing is avoided.

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<sup>368</sup> Nokia Comments at 31-32, Samsung Comments at 36.

<sup>369</sup> Verizon Comments at 4, CEA Comments at 13.

<sup>370</sup> ViaSat Comments at 13. ViaSat uses the purported shortcomings of performance requirements in ensuring spectrum utilization to argue in favor of adopting a non-exclusive terrestrial regime in these bands rather than an exclusive one. It argues that the latter type of regime would ensure maximum spectrum utilization by promoting sharing between satellite and terrestrial services. *Id.* at 12-13.

<sup>371</sup> Straight Path Comments at 25, Vivint Reply Comments at 2.

202. We observe that several commenters supported the adoption of reasonable performance requirements in these bands, though they did not propose or endorse any specific benchmarks.<sup>373</sup> Other commenters, though they did not explicitly endorse performance requirements, suggested that adjusted performance requirements were options that should be considered.<sup>374</sup> We encourage comment on whether our proposal strikes the appropriate balance between requirements that are too low as to not result in meaningful buildout and those that would be so high as to be unattainable. We also seek comment on whether other benchmarks represent more appropriate requirements. Commenters should discuss and quantify how any supported buildout requirements will affect investment and innovation, as well as discuss and quantify other costs and benefits associated with their proposals. We continue to believe that performance requirements play a critical role in ensuring that licensed spectrum does not lie fallow. At the same time, however, we recognize that the unique characteristics of frequencies above 24 GHz may require us to adopt a thoughtfully calibrated approach to performance requirements. We recognize that these unique characteristics are likely to cause prospective licensees in these bands to be interested in serving relatively small geographic areas (*e.g.*, urban areas), at least in the short-to-medium term. Accordingly, we are proposing a smaller coverage requirement than we have recently applied in other lower frequency bands. We seek comment on applying performance requirements at the county level. Is there another more appropriate geographic unit we should use for evaluating compliance with performance requirements?

### c. Performance Metrics

203. Under the Communication's Act, we have an obligation to adopt rules that prevent the warehousing of spectrum, and we have an interest in doing so – it is our goal to create a regulatory scheme that promotes the rapid and widespread deployment of wireless broadband, to consumers' benefit. The Commission commonly measures performance on the basis of population covered by a licensee in a license area.<sup>375</sup> This approach can be readily adopted to wide-area coverage based fixed systems (point-to-multipoint systems). For licensees providing fixed, point-to-point links, the Commission has generally evaluated buildout using a different metric – it compares the number of links in operation to the population of the license area.<sup>376</sup> The Commission has also evaluated buildout, including in rural areas, by the percentage of land area served by a licensee.<sup>377</sup>

204. We believe, given that technologies under development for these bands could be used for “fixed” or “mobile” uses, as described below, that it would be highly desirable to have a universal performance metric that could work across various types of services. Otherwise, we open the possibility

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<sup>373</sup> Straight Path Comments at 25, Straight Path Reply Comments at 14, Qualcomm Comments at 17, NYU Wireless Comments at 30.

<sup>374</sup> Nokia Comments at 31-32, Samsung Comments at 36.

<sup>375</sup> *See, e.g.*, 47 C.F.R. §§ 27.14(q)(2) (“An AWS-4 licensee shall provide terrestrial signal coverage and offer terrestrial service within seven (7) years from the date of the license to at least seventy (70) percent of the population in each of its license areas. . .”); (r)(1), (2) (AWS-3 bands).

<sup>376</sup> *See, e.g.*, 47 C.F.R. §§ 27.14 (o)(1)(i) (For BRS and EBS, constructing six permanent links per one million people constitutes substantial service), (p)(2) (for 2.3 GHz WCS, “For point-to-point fixed systems, except those deployed in the Gulf of Mexico license area, a licensee must construct and operate a minimum of 15 point-to-point links per million persons (one link per 67,000 persons) in a license area by March 13, 2017, and 30 point-to-point links per million persons (one link per 33,500 persons) in a licensed area by September 13, 2019.”)

<sup>377</sup> For example, in establishing a rural safe harbor, the Commission has suggested that serving at least seventy-five percent of the geographic area of a certain percentage of rural counties in a service area could be another means of meeting a buildout requirement. *See, e.g.*, Facilitating the Provision of Spectrum-Based Services to Rural Areas and providing Opportunities for Rural Telephone Companies to Provide Spectrum-Based Services, *Report and Order and Further Notice of Proposed Rule Making*, 19 FCC Rcd 19078, 19123 ¶ 79 (2004); 47 C.F.R. § 27.14(o)(1)(iii)(A).

of gaming the performance requirements, which would be counter to our statutory obligation and our policy prerogative. For example, if we adopted different buildout requirements for different services under the same license, a licensee might choose the lowest-common-denominator metric in order to provide a safe harbor for performance, even if this metric does not match the licensee's actual plans to build out a network. We believe, in general, it would be better to have a single metric covering different varieties of network deployment in these bands.

205. With this in mind, we seek comment on the appropriate type of metric to be used in evaluating buildout in the mmW bands. Is it feasible and appropriate to develop a unified metric combining fixed, mobile, and satellite service? If so, what is the best way to define that metric?

206. Of the three traditional performance metrics, it appears that population coverage is the one most naturally suited to encompass both mobile and fixed network topologies. For each of these uses, it should be possible to develop a service contour and calculate its coverage in terms of the population within the coverage area. For a short-range mobile networks, we might expect this coverage area to be a ring concentrated around each base station. For longer-range fixed links, a narrow "keyhole" contour may be applicable. Regardless, both could be determined in terms of a common unit of measurement, *i.e.*, a measure of population that is served by the station. We seek comment on whether such a population-based approach would be appropriate for the Upper Microwave Flexible Use service. We also seek comment on the alternative of using an area-based metric.

207. If we use a population-based metric, we proposed to require that the applicant demonstrate that it is providing reliable signal coverage and that the applicant demonstrate that it is using the facilities to provide service, either to customers or for internal use. In terms of providing reliable signal coverage, we propose to measure coverage at the census block level, and that a census block will be considered "covered" if a reliable signal level is placed over the centroid of the census block. Under this methodology if a licensee provides coverage to a census block or multiple census blocks that have a total population equal to 40% of the population of the county the licensee would be deemed to meet the performance requirement and would retain the license for the entire county. We seek comment on this methodology or whether, alternatively, we should use some other methodology for determining coverage. In terms of defining service, we propose to require that a licensee demonstrate that all of the requisite infrastructure elements are in place and operational (including certified radio equipment, power, backhaul, etc.) and that the radio facilities are part of a network that provides ongoing service to unaffiliated paying subscribers or for *bona fide* private uses.<sup>378</sup> We also seek comment on what engineering methodology would be appropriate to ensure consistent measurement of service area across different network topologies and technologies.

208. We also seek comment on alternative ways to measure population if we use a population-based metric. To the extent systems are used primarily at businesses, is there any way to reliably measure the daytime population within an area? If a system is used to serve an area with a heavy tourist or transient population, is it possible and appropriate to measure those types of populations?

209. Alternatively, is there some other method to normalize performance measurement so that it applies consistently to both fixed and mobile network deployments? For example, is it possible to assign some sort of population-based metric or area-based metric to a fixed-point-to-point link? What factors would be appropriate to consider in assigning a population or area to a fixed link (*e.g.*, population in or near the location of the link, interference contour around the link)? Are there other non-population based technical metrics that should be considered in measuring performance (*e.g.*, use of services associated with the link, capacity of the link)? Is there some metric other than population, land area, or number of links that we should consider?

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<sup>378</sup> We used similar criteria in establishing criteria for protection of grandfathered operations in the 3650-3700 MHz band. See *3.5 GHz R&O*, 30 FCC Rcd at 4077 ¶ 403.

210. We also seek comment on the possible alternative of having a separate performance requirement for fixed services. In LMDS, the Commission required licensees to provide substantial service. The Commission elaborated on what may constitute substantial service by offering some specific examples, which are sometimes referred to as safe harbors, to provide LMDS licensees with a degree of certainty as to how to comply with the substantial service requirement by the end of the initial license term.<sup>379</sup> The Commission explained that an LMDS licensee that chooses to offer fixed, point-to-point services may fall within a safe harbor by constructing four permanent links per one million people in its licensed service area.<sup>380</sup> We seek comment on the advantages and disadvantages of adopting a performance benchmark for fixed services based on the number of links compared to the population in a licensee's service area. We also seek comment on how we would reconcile performance requirements that vary depending on the type of service provided to ensure the spectrum is being put to use.

211. As noted above, we are seeking comment on means of facilitating sharing between terrestrial licensees in the 28 GHz, 37 GHz, and 39 GHz bands and FSS operators.<sup>381</sup> We seek comment on whether it would be possible to incorporate satellite operations into a unified engineering metric. If we do not develop a unified metric, we propose that a FSS operator holding an Upper Microwave Flexible Use license used in association with an earth station be required to demonstrate that the earth station is in operation and providing service. We seek comment on what factors we should consider in determining whether the earth station is providing service. Should we use the same criteria we listed above?

#### **d. Performance Milestones**

212. The mmW bands have propagation characteristics that are well-suited for high bandwidth applications and intensive spectral reuse. However, because of the relatively small coverage area of a site operating on mmW spectrum, deploying a wide-area network may not be ideal, or it may not be necessary given the potential that these bands will provide primarily capacity, at least in cellular-type applications. In addition, given the nascent state of technology in these bands, we anticipate that it will take substantially longer to deploy these systems than in lower frequency bands. We also anticipate that initial deployments in these bands will take place in highly localized areas where there is demand for the speed and other characteristics these systems will provide.

213. Therefore, we propose that an Upper Microwave Flexible Use licensee providing mobile or point-to-multipoint service provide reliable signal coverage and offer service to at least 40 percent of the population in each of its county-based license areas at the end of the initial license term. We also propose to incorporate point-to-point operations into a population-based metric using the "keyhole" contour and include the population in that area within the keyhole contour in determining the population served by a station. We seek comment on this proposal. If, instead, we adopt the area-based metric described above, we would require an area coverage milestone that would be calibrated to be equivalent to 40 percent of the population. We seek comment on whether this calibration should represent the land area encompassing approximately 40 percent of population for the average U.S. county or whether it should be calibrated separately for each county in the United States. If we adopt separate benchmarks for fixed operations, we seek comment on what those benchmarks should be. We also seek comment on adopting a special rule that FSS licensees using Upper Microwave Flexible Use licenses in connection with FSS earth stations would be required to show that the associated earth station was in operation and providing service. We seek comment on these proposals, as well as alternatives.

#### **e. Penalty**

214. We propose that if a licensee fails to meet the buildout requirement in any county, its authorization for each county in which it fails to meet the requirement would terminate automatically

<sup>379</sup> See *Second LMDS Report and Order*, 12 FCC Rcd at 12660-12661 ¶¶ 269-270.

<sup>380</sup> See *Second LMDS Report and Order*, 12 FCC Rcd at 12660 ¶ 270.

<sup>381</sup> See Section IV.B.5, *supra*.

without Commission action. This penalty is widely applied in many wireless services.<sup>382</sup> We seek comment on this proposal. Are there any alternative penalties that may be appropriate?

**f. Use-or-Share Obligation**

215. One of the most important characteristics of bands above 24 GHz is that the propagation and atmospheric absorption characteristics result in shorter range communications. While those characteristics provide challenges, they also provide greater opportunity for frequency reuse without interference.<sup>383</sup> Accordingly, we believe these bands are particularly good candidates for sharing. At the same time, a sharing mechanism can discourage warehousing and other improper behavior that result in spectrum not being used. We believe a “use-or-share” rule would provide another mechanism for ensuring that spectrum is put to productive use.

216. We propose that portions of a license area that remain unused after 5 years after the initial license is issued, or, for incumbent licensees, five years after the effective date of the new rules, be made available for shared use by other users. This shared use would be on a non-interfering basis to the licensees’ use. We propose that after the first five years, the extent of unused spectrum could continue to change. In other words, a licensee would be free to expand its operations (with the requirement that other users retract service from the expanded area) or a licensee could reduce its operations (making more portions of the license area available for shared access). We seek comment on this proposal, including the costs and benefits.

217. We also seek comment on establishing a specific framework for sharing. How should we define “unused spectrum” for these purposes (or conversely, how would we define “use” for these purposes)? We have previously proposed that licensees be required to make available information on their proposed facilities.<sup>384</sup> Would that information be sufficient to provide information on what constituted “unused spectrum?” What would be the best way to define and determine what areas were unused? Should we adopt technical criteria for determining when spectrum is used? If so, what are the appropriate criteria? Should shared use be authorized on a licensed basis or under Part 15 of the Commission’s rules? What mechanism should be used to maintain sharing boundaries and prevent harmful interference? Would an SAS be the best means of administering a sharing mechanism, or should the Commission adopt some other coordination mechanism? We seek comment on these and all other issues associated with establishing a sharing framework.

**g. Service after the Initial License Term**

218. We seek comment on what requirements we should apply in the Upper Microwave Flexible Use Service after a licensee makes a performance showing after its initial license term. We intend to create a mechanism to require that this spectrum is continually used, including ensuring that licensees that have met their performance requirements continue to provide service and expand their networks. As technology develops for these bands, should we require licensees to make more stringent construction showings after the initial license term? If so, what should those additional requirements be, and when should they apply? If a licensee substantially reduces service after making its initial buildout showing, should it be subject to penalties over and above the obligation to share spectrum? Are there other requirements we should impose in order to ensure that spectrum continues to be put in use? For instance, should we require a performance showing, even using the exact same metric, at some regular interval after the initial performance deadline?

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<sup>382</sup> See 47 C.F.R. § 1.955(a)(2).

<sup>383</sup> See CEA Comments at 13 (“The shorter waves in the mmW bands require a much greater density of base stations – density that would be present in urban areas – than mobile broadband at the lower spectrum bands.”) See also n. 285, *supra*.

<sup>384</sup> See ¶¶ 152-153, *supra*.

#### **h. Treatment of Incumbent Licenses**

219. We recognize that current LMDS and 39 GHz licensees may be planning to meet current requirements concerning substantial service and renewal expectancy. In order to provide a smooth transition, we propose to apply the existing performance requirement to incumbent LMDS and 39 GHz licensees at the end of their current license terms, so long as the license term expires prior to March 1, 2021. We recognize that current licensees will have a difficult choice – to try to acquire new equipment and deploy right at the potential launch of mobile mmW services (expected around 2020), or provide innovative fixed services. We seek comment on this proposal. Alternatively, we seek comment on allowing current licensee to meet their performance requirements under the current rules at some earlier date, for example 2018.

#### **i. Alternatives to Construction-Based Performance Requirements**

220. We acknowledge that some commenters question whether traditional performance requirements are necessary or appropriate in these bands, based on observations about market incentives to use spectrum and the unique characteristics of millimeter frequencies.<sup>385</sup> We believe, for the reasons described above, that performance requirements are an important tool to ensure that spectrum is utilized. However, we also recognize that traditional performance requirements in these bands would create certain challenges. These challenges include taking into account the unique difficulties for licensees that try to deploy networks using these bands, as well as the difficulties the Commission would have in enforcing performance requirements in 3,143 counties nationwide. Therefore, we also seek comment on alternative approaches we might take to ensuring deployment and spectrum utilization, as well as the costs and benefits of adopting any of those approaches.

221. First, we seek comment on whether the consecutive license concept discussed below would provide strong incentives to productive use that might obviate the need for construction-based performance milestones.<sup>386</sup> Under that proposal, prospective millimeter wave licensees could bid for a license in a given county in a single, one-time auction, and the winning bidder in that auction would be required to pay the auction price, adjusted for inflation, before the start of each five-year license term; once the winning bidding made this payment before a five-year license term, a new license would be issued to the licensee for that five-year term. Such an approach would be one way to incentivize construction of network facilities and spectrum use, given that a licensee would be unlikely to pay the auction price in successive license terms unless it could come up with a viable long-term plan for using the spectrum. That approach could also make traditional performance requirements unnecessary because a licensee would be unlikely to make future payments for spectrum it does not intend to use. We seek comment on these approaches, and other alternative approaches we might take, as well as the costs and benefits of adopting any of these approaches.

222. Second, we also seek comment on separating interference and exclusion rights using an “option” concept to accomplish the goals of performance requirements. In the 3.5 GHz proceeding, we recently sought comment on a proposal to define “use” of priority access licenses in such a way as to separate the right to operate without interference from the right to exclude other users. Under that proposal, the priority access licensee would have the right, but not the obligation, to exclude other users by making an additional “option” payment.<sup>387</sup> If this concept has merit, how should the idea be adapted to comport with the other proposals contained in this proceeding?

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<sup>385</sup> See Verizon Comments at 4, CEA Comments at 13. See also ViaSat Comments at 13.

<sup>386</sup> See ¶¶ 255-256, *infra*.

<sup>387</sup> See *3.5 GHz 2<sup>nd</sup> FNPRM*, 30 FCC Rcd at 4083 ¶ 425. For a recent discussion of the concept, see William Lehr, *Spectrum License Design, Sharing, and Exclusion Rights* (Aug. 15, 2015), available at [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2587877](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2587877).

223. We also seek comment on any other alternatives to construction-based performance requirements that may be appropriate in the context of the other rules we propose herein.

**j. Performance Requirements and Part 25 Operations**

224. As noted above, we are seeking comment on means of facilitating sharing between terrestrial licensees in the 28 GHz, 37 GHz, and 39 GHz bands and FSS operators.<sup>388</sup> We seek comment on whether it would be appropriate to make any adjustments to our performance requirements to facilitate such sharing. As noted above, we seek comment on what FSS licensees using Upper Microwave Flexible Use licenses in connection with FSS earth stations would be required to show to demonstrate that the associated earth station was in operation and providing service.<sup>389</sup> We seek comment on these issues, as well as other issues relating to the intersection between performance requirements and sharing with satellite operators.

**7. Permanent Discontinuance of Operations**

225. For Upper Microwave Flexible Use Service licensees, for providers that identify their regulatory status as common carrier or non-common carrier, we propose to define “permanently discontinued” as a period of 180 consecutive days during which the licensee does not provide service to at least one subscriber that is not affiliated with, controlled by, or related to, the provider in the service area of its license (or smaller service area in the case of a partitioned license). Under section 1.955(a)(3) of the Commission's rules, an authorization will automatically terminate, without specific Commission action, if service is “permanently discontinued.”<sup>390</sup> The permanent discontinuance rule is intended to provide operational flexibility while ensuring that spectrum does not lie idle for extended periods.

226. We propose a different approach, however, for licensees that use their licenses for private, internal communications, because such licensees generally do not provide service to unaffiliated subscribers. For such private, internal communications, we propose to define “permanent discontinuance” as a period of 180 consecutive days during which the licensee does not operate. Licensees would not be subject to this requirement until 1 year after their initial license period ends, so they will have adequate time to construct their network. Allowing such licensees one year before they are subject to permanent discontinuance is also consistent with the current Part 101 permanent discontinuance rules.

227. In addition, consistent with section 1.955(a)(3) of the Commission's rules, we propose that, if a 28 GHz, 37 GHz, or 39 GHz licensee permanently discontinues service, the licensee must notify the Commission of the discontinuance within 10 days by filing FCC Form 601 and requesting license cancellation. An authorization will automatically terminate without specific Commission action if service is permanently discontinued even if a licensee fails to file the required form. We seek comment on these proposals, including the associated costs and benefits.

228. The approach to permanent discontinuance described above is consistent with the definition that the Commission has adopted for other spectrum bands that are licensed for mobile use, including the H Block, AWS-3, and AWS-4 bands.<sup>391</sup> We note that the discontinuance periods in the Part 101 rules are different, but we tentatively conclude that those requirements are more applicable to site-licensed microwave licenses.<sup>392</sup> We seek comment on our proposal.

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<sup>388</sup> See Section IV.B.5, *supra*.

<sup>389</sup> See ¶ 210, *supra*.

<sup>390</sup> 47 C.F.R. § 1.955(a)(3).

<sup>391</sup> See 47 C.F.R. § 27.17.

<sup>392</sup> 47 C.F.R. § 101.305.

## 8. Secondary Markets

### a. Partitioning and Disaggregation

229. *Background.* The Commission's Part 101 rules generally allow for geographic partitioning and spectrum disaggregation in the LMDS and 39 GHz service.<sup>393</sup> Geographic partitioning refers to the assignment of geographic portions of a license to another licensee along geopolitical or other boundaries. Spectrum disaggregation refers to the assignment of discrete amounts of spectrum under the license to another entity. Disaggregation allows for multiple transmitters in the same geographic area operated by different companies on adjacent frequencies in the same band.

230. In 1997, the Commission determined that all LMDS licensees would generally be permitted to disaggregate and partition their licenses.<sup>394</sup> The Commission later adopted specific procedural, administrative, and operational rules to govern the disaggregation and partitioning of LMDS licenses.<sup>395</sup> Similarly, in the same year, the Commission concluded that partitioning and disaggregation would be permitted in the 39 GHz band; and it adopted rules to govern partitioning and disaggregation in that band as well.<sup>396</sup>

231. We did not address the issue of secondary market transactions, including partitioning and disaggregation, in the *NOI*. Nonetheless, several commenters addressed this area, and those that did were universally supportive of allowing secondary market transactions in general and of allowing partitioning and disaggregation in particular.<sup>397</sup>

232. *Discussion.* We propose to continue permitting partitioning and disaggregation by 28 GHz and 39 GHz licensees and to allow 37 GHz licensees to partition or disaggregate their licenses. As the Commission noted when first establishing partitioning and disaggregation rules, allowing such flexibility could facilitate the efficient use of spectrum by enabling licensees to make offerings directly responsive to market demands for particular types of services, increasing competition by allowing new entrants to enter markets, and expediting provision of services that might not otherwise be provided in the near term.<sup>398</sup> This policy would leave the decision of determining the correct size of licenses to the licensees and the marketplace, which is consistent with the flexible approach to licensing these bands that we have proposed in this *NPRM*.

233. To ensure that the public interest would be served if partitioning or disaggregation is allowed, we propose requiring each licensee in these bands that is a party to a partitioning, disaggregation, or combination of both, to independently meet the applicable performance and renewal requirements.<sup>399</sup> We believe this approach would facilitate efficient spectrum use, while enabling service

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<sup>393</sup> See 47 C.F.R. § 101.15.

<sup>394</sup> *Second LMDS Report and Order*, 12 FCC Rcd at 12608 ¶¶ 144-45.

<sup>395</sup> See Rule Making to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, To Reallocate the 29.5-30.0 GHz Frequency Band, To Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services, CC Docket No. 92-297, *Fourth Report and Order*, 13 FCC Rcd 11655 (1998) (*LMDS Fourth Report and Order*). See also 47 C.F.R. § 101.1111.

<sup>396</sup> *39 GHz R&O*, 12 FCC Rcd at 18635-36 ¶¶ 71-74; 47 C.F.R. § 101.56.

<sup>397</sup> Verizon Wireless Comments at 4, Samsung Comments at 21, Vivint Reply Comments at 2, Straight Path Reply Comments at 14, NYU Wireless Comments at 39.

<sup>398</sup> Geographic Partitioning and Spectrum Disaggregation by Commercial Mobile Radio Service Licensees, WT Docket No. 96-148, *Report and Order and Further Notice of Proposed Rulemaking*, 11 FCC Rcd 21831, 21833 ¶ 1 (1996).

<sup>399</sup> We note that partition and disaggregation is subject to the Commission's unjust enrichment rules. See *infra* Section IV.E.10. See also 47 C.F.R. § 1.2111(e).

providers to configure geographic area licenses and spectrum blocks to meet their operational needs.<sup>400</sup> We seek comment on these proposals. Commenters should discuss and quantify the costs and benefits of these proposals with respect to competition, innovation, and investment.

234. We also seek comment on whether the Commission should adopt additional or different mechanisms to encourage partitioning and/or disaggregation of 28 GHz, 37 GHz, and 39 GHz spectrum, and the extent to which such policies ultimately may promote more service. Commenters should discuss and quantify the costs and benefits of promoting more service using mechanisms to encourage partitioning and disaggregation of spectrum in these bands, including the effects of any proposals.

### b. Spectrum Leasing

235. *Background.* In 2003, in order to promote more efficient use of terrestrial wireless spectrum through secondary market transactions and in order to eliminate regulatory uncertainty, the Commission adopted the *Secondary Markets First Report and Order*, which contained a comprehensive set of policies and rules to govern spectrum leasing arrangements between terrestrial licensees and spectrum lessees.<sup>401</sup> These policies and rules enabled terrestrially based Wireless Radio Service licensees holding “exclusive use” spectrum rights to lease some or all of the spectrum usage rights associated with their licenses to third party spectrum lessees.<sup>402</sup> Those third party lessees were then permitted to provide wireless services consistent with the underlying license authorization.<sup>403</sup>

236. In the 2003 *Secondary Markets First Report and Order*, the Commission excluded a number of wireless radio services from the rules and policies, including Part 101 services.<sup>404</sup> In 2004, however, the Commission extended the 2003 spectrum leasing policies to a number of additional wireless services, including Part 101 services.<sup>405</sup> At that time, the Commission also built upon the 2003 spectrum leasing framework by establishing immediate approval procedures for certain categories of terrestrial spectrum leasing arrangements.<sup>406</sup>

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<sup>400</sup> See generally Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 to Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services, WT Docket No. 10-112, *Notice of Proposed Rulemaking and Order*, 25 FCC Rcd 6996, 6998-99, 7029-33 ¶¶ 5, 91-97 (2010) (*WRS Renewals NPRM and Order*).

<sup>401</sup> Promoting Efficient Use of Spectrum Through Elimination of Barriers to the Development of Secondary Markets, WT Docket No. 00-230, *Report and Order and Further Notice of Proposed Rulemaking*, 18 FCC Rcd 20604 (2003) (*Secondary Markets First Report and Order*), *Erratum*, 18 FCC Rcd 24817 (2003).

<sup>402</sup> *Secondary Markets First Report and Order*, 18 FCC Rcd at 20609-20613, 20648-20649 ¶¶ 8-9, 12-13, 91-92. Wireless Radio Services do not include satellite services. 47 C.F.R. § 1.907. Under these secondary market policies and rules, the service rules and policies applicable to the licensee under its license authorization – including all technical, interference, and operational rules – apply to the spectrum lessee as well. *Secondary Markets First Report and Order*, 18 FCC Rcd at 20648-20649 ¶¶ 91-92; see 47 C.F.R. §§ 1.9020(c)-(d), 1.9030 (c)-(d), 1.9035(c)-(d). The rules and procedures for spectrum leasing arrangements are set forth in Part 1, Subpart X. 47 C.F.R §§ 1.9001 *et seq.*

<sup>403</sup> *Secondary Markets First Report and Order*, 18 FCC Rcd at 20648-20649 ¶¶ 91-92.

<sup>404</sup> *Id.*

<sup>405</sup> Promoting Efficient Use of Spectrum Through Elimination of Barriers to the Development of Secondary Markets, WT Docket No. 00-230, *Second Report and Order, Order on Reconsideration, and Second Further Notice of Proposed Rulemaking*, 19 FCC Rcd 17503 (2004) (*Secondary Markets Second Report and Order*).

<sup>406</sup> *Id.*

237. As mentioned, we did not address secondary market transactions at all in the *NOI*. Regardless, in addition to voicing support for allowing secondary market transactions, several commenters also specifically supported allowing spectrum leasing arrangements.<sup>407</sup>

238. *Discussion.* We propose that the spectrum leasing policies and rules established in those proceedings be applied to the new Part 30 radio service governing Upper Microwave Flexible Use Services, including all 28 GHz, 39 GHz, and 37 GHz terrestrial licensees. We propose to apply these rules and policies in the same manner that those policies apply to Part 101 services.<sup>408</sup> Our secondary markets policies are designed to promote more efficient, innovative, and dynamic use of the spectrum, expand the scope of available wireless services and devices, enhance economic opportunities for accessing spectrum, and promote competition among providers.<sup>409</sup> Likewise, allowing spectrum leasing in these bands will serve these same purposes. We also observe that “[f]or a particular spectrum band, spectrum leasing policies generally follow the same approach as the partitioning and disaggregation policies for the band.”<sup>410</sup> Thus, our proposal to permit spectrum leasing in the 28 GHz, 39 GHz, and 37 GHz services is consistent with our determination above to permit partitioning and disaggregation in these spectrum bands.<sup>411</sup>

239. We seek comment on this proposal. Commenters should discuss the effects on competition, innovation and investment, and on extending our secondary spectrum leasing policies and rules to these bands.

## 9. Other Operating Requirements

240. Regardless of which radio service or rule part the licenses in the these bands are issued pursuant to, licensees may be required to comply with rules contained in other parts of the Commission’s rules depending on the particular services they provide. For example:

- Applicants and licensees will be subject to the application filing procedures for the Universal Licensing System, set forth in Part 1 of our rules.<sup>412</sup>
- To the extent a licensee provides a Commercial Mobile Radio Service (CMRS), such service would be subject to the provisions of Part 20 of the Commission's rules, along with the provisions in the rule part under which the license was issued. Part 20 applies to all CMRS providers, even though the stations may be licensed under other parts of our rules.
- The application of general provisions of Parts 22, 24, 27, or 101 would include rules related to equal employment opportunity, 911 service, etc.

241. We seek comment generally on any provisions in existing, service-specific rules that may require specific recognition or adjustment to comport with the supervening application of another rule part, as well as any provisions that may be necessary in this other rule part to fully describe the scope of covered services and technologies. We seek comment on applying these rules to the spectrum that is the subject of this *NPRM*, and specifically on any rules that would be affected by our proposal to apply elements of the framework of these parts, whether separately or in conjunction with other requirements.

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<sup>407</sup> Verizon Wireless Comments at 4; Samsung Reply Comments at 21; Vivint Reply Comments at 2; Straight Path Reply Comments at 14; NYU Wireless Comments at 39.

<sup>408</sup> *Id.* See e.g., 47 C.F.R. 1.9005(j).

<sup>409</sup> See *Secondary Markets First Report and Order*, 18 FCC Rcd at 20607 ¶ 2.

<sup>410</sup> Service Rules for Advanced Wireless Services in the 2000-2020/2180-2200 MHz Bands, *et al.*, WT Docket No. 12-70, *et al.*, *Report and Order and Order of Proposed Modification*, 27 FCC Rcd 16102, 16198 ¶ 258 (2012) (*AWS-4 Service Rules R&O*).

<sup>411</sup> See *supra* at Section IV.E.8.a.

<sup>412</sup> See 47 C.F.R. Part 1, Subpart F.

242. We propose, therefore, to also require Upper Microwave Flexible Use Service licensees to comply with certain other rule parts that pertain generally to wireless communications services. This approach will maintain general consistency among various wireless communications services. Further, we seek comment on whether we need to add any rules in order to ensure that we cover licensees in these bands under the necessary Commission rules. Finally, we seek comment on any rules that would be affected by the proposal to apply elements of the framework of these rule parts, whether separately or in conjunction with other requirements.

#### 10. Competitive Bidding Procedures

243. As discussed above, we propose to redesignate the existing LMDS and 39 GHz licenses as a new radio service combining mobile and fixed rights, in which case the existing fixed licensees would be assigned new licenses. We note that, of the 986 designated LMDS license areas, 416 have active licenses at this time, and of the 2,464 designated 39 GHz license areas, 859 have active licenses at this time. Further, because we have never licensed 37 GHz for fixed or mobile use, there are currently no active terrestrial licenses in that spectrum.

244. We have a statutory obligation to use competitive bidding to resolve mutually exclusive applications for licenses. Section 309(j) of the Communications Act requires that the Commission assign initial licenses through the use of competitive bidding when mutually exclusive applications for such licenses are accepted for filing, except in the case of certain specific statutory exemptions.<sup>413</sup> This statutory mandate applies to the mmW bands. Consistent with the Commission's policy that competitive bidding places licenses in the hands of those that value the spectrum most highly, we believe that it would be in the public interest to adopt a licensing scheme for the Upper Microwave Flexible Use Service which allows the filing of mutually exclusive applications that, if accepted, would be resolved through competitive bidding.

245. Under the proposed licensing scheme,<sup>414</sup> we propose to resolve all applications and license assignments in areas where there is currently no active licensee through competitive bidding, consistent with our statutory mandate under Section 309(j). We seek comment on this proposal. Additionally, we seek comment on a number of proposals relating to competitive bidding procedures discussed below, including the costs and benefits of those proposals.

##### a. Application of Part 1 Competitive Bidding Rules

246. We propose that the Commission would conduct any auction for licenses of spectrum in the Upper Microwave Flexible Use Service in conformity with the general competitive bidding rules set forth in Part 1, Subpart Q, of the Commission's rules, and generally consistent with the competitive bidding procedures that have been employed in previous auctions.<sup>415</sup> In July 2015, the *Competitive Bidding Update Report & Order* amended the Commission's Part 1 competitive bidding rules by, among other things, updating the standardized schedule of small business size standards,<sup>416</sup> instituting a rural service provider bidding credit,<sup>417</sup> and adopting a process by which we may establish a reasonable monetary limit or cap on the total amount of bidding credits that an eligible small business or rural service provider may be awarded in any particular auction. Specifically, we propose to employ the Part 1 rules

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<sup>413</sup> See 47 U.S.C. § 309(j)(1), (2).

<sup>414</sup> See Section IV.B.1 and IV.B.2, *supra*.

<sup>415</sup> See 47 C.F.R. §§ 1.2101-1.2114.

<sup>416</sup> See Updating Part 1 Competitive Bidding Rules, *et al.*, WT Docket No. 14-170, *et al.*, *Report and Order; Order on Reconsideration of the First Report and Order; Third Order on Reconsideration of the Second Report and Order; Third Report and Order*, 30 FCC Rcd 7493, 7524-7525 ¶ 74 (2015) ("*Competitive Bidding Update Report & Order*").

<sup>417</sup> See *Competitive Bidding Update Report & Order*, 30 FCC Rcd at 7530-7531 ¶ 88.

governing competitive bidding design, designated entity preferences, unjust enrichment, application and payment procedures, reporting requirements, and the prohibition on certain communications between auction applicants.<sup>418</sup> Under this proposal, such rules would be subject to any further modifications that the Commission may adopt for its Part 1 general competitive bidding rules in the future. Consistent with our longstanding approach, we will initiate a public notice process to solicit public input on certain details of auction design and the auction procedures. This public notice process will address auction-specific matters such as the competitive bidding design and mechanisms, minimum opening bids and/or reserve prices, caps on bidding credits, and payment procedures. In advance of the auction, another public notice will announce the auction procedures and provide detailed instructions for potential auction participants. We seek comment on whether any of our Part 1 rules would be inappropriate or should be modified for an auction of licenses in these frequency bands.

**b. Small Business Provisions for Geographic Area Licenses**

247. *Background.* In authorizing the Commission to use competitive bidding, Congress mandated that the Commission “ensure that small businesses, rural telephone companies, and businesses owned by members of minority groups and women are given the opportunity to participate in the provision of spectrum-based services.”<sup>419</sup> In addition, Section 309(j)(3)(B) of the Act provides that, in establishing eligibility criteria and bidding methodologies, the Commission shall seek to promote a number of objectives, including “economic opportunity and competition . . . by avoiding excessive concentration of licenses and by disseminating licenses among a wide variety of applicants, including small businesses, rural telephone companies, and businesses owned by members of minority groups and women.”<sup>420</sup> One of the principal means by which the Commission fulfills this mandate is through the award of bidding credits to small businesses.

248. In the *Competitive Bidding Second Memorandum Opinion and Order*, the Commission stated that it would define eligibility requirements for small businesses on a service-specific basis, taking into account the capital requirements and other characteristics of each particular service in establishing the appropriate threshold.<sup>421</sup> Further, in the *Part 1 Third Report and Order* and the more recent *Competitive Bidding Update Report & Order*, the Commission, while standardizing many auction rules,

<sup>418</sup> See, e.g., Amendment of Part 1 of the Commission’s Rules—Competitive Bidding Procedures, WT Docket No. 97-82, *Order, Memorandum Opinion and Order and Notice of Proposed Rule Making*, 12 FCC Rcd 5686 (1997); *Third Report and Order and Second Further Notice of Proposed Rule Making*, 13 FCC Rcd 374 (1997) (“*Part 1 Third Report and Order*”); *Order on Reconsideration of the Third Report and Order, Fifth Report and Order, and Fourth Further Notice of Proposed Rule Making*, 15 FCC Rcd 15293 (2000), *aff’d in part and modified in part, Second Order on Reconsideration of the Third Report and Order, and Order on Reconsideration of the Fifth Report and Order*, 18 FCC Rcd 10180 (2003); *Seventh Report and Order*, 16 FCC Rcd 17546 (2001); *Eighth Report and Order*, 17 FCC Rcd 2962 (2002); *Second Order on Reconsideration of the Part 1 Fifth Report and Order*, 20 FCC Rcd 1942 (2005); Implementation of the Commercial Spectrum Enhancement Act and Modernization of the Commission’s Competitive Bidding Rules and Procedures, WT Docket 05-211, *Report and Order*, 21 FCC Rcd 891 (2006) (“*CSEA/Part 1 Report and Order*”), *recons. pending*; *Second Report and Order and Second Further Notice of Proposed Rule Making*, 21 FCC Rcd 4753 (2006) (“*CSEA/Part 1 Designated Entity Second Report and Order and Second FNPRM*”), *recons. pending*; *Order on Reconsideration of the Second Report and Order*, 21 FCC Rcd 6703 (2006) (modified by *Erratum and Notice of Office of Management and Budget Approval of Information Collections*, 21 FCC Rcd 6622 (WTB 2006)), *petition for review dismissed sub nom. Council Tree Communications, Inc. v. FCC*, 503 F.3d 284 (3d Cir. 2007); *Second Order on Reconsideration of the Second Report and Order*, 23 FCC Rcd 5425 (2008), *vacated in part, Council Tree Communications, Inc. v. FCC*, 619 F.3d 235 (3d Cir. 2010); *Order*, FCC 12-12 (Feb. 1, 2012).

<sup>419</sup> 47 U.S.C. § 309(j)(4)(D).

<sup>420</sup> *Id.* § 309(j)(3)(B).

<sup>421</sup> Implementation of Section 309(j) of the Communications Act—Competitive Bidding, PP Docket No. 93-253, *Second Memorandum Opinion and Order*, 9 FCC Rcd 7245, 7269 ¶ 145 (1994); 47 C.F.R. § 1.2110(c)(1).

determined that it would continue a service-by-service approach to defining small businesses.<sup>422</sup> As noted above, we recently updated our standardized schedule of small business size standards and associated bidding credits. Under the new standardized schedule, businesses with average annual gross revenues for the preceding three years not exceeding \$4 million would be eligible for a 35 percent bidding credit, businesses with average annual gross revenues for the preceding three years not exceeding \$20 million would be eligible for a 25 percent bidding credit, and businesses with average annual gross revenues for the preceding three years not exceeding \$55 million would be eligible for a 15 percent bidding credit.<sup>423</sup>

249. *Discussion.* We propose to use for the 28 GHz, 37 GHz, and 39 GHz bands the standardized schedule of small business size standards we adopted in the *Competitive Bidding Update Report & Order*. We also propose to provide qualifying “small businesses” with a bidding credit of 15 percent and qualifying “very small businesses” with a bidding credit of 25 percent in future auctions of licenses in these services. We have used these bidding credits in a range of other services<sup>424</sup> and in instances where “[w]e do not know the precise type of service that new licensees may attempt to provide in this band.”<sup>425</sup> In the absence of any information in the record at this point about the capital requirements to allow us to tentatively conclude otherwise, we propose to use the two small business definitions with higher gross revenues thresholds. Thus, we propose to define a small business as an entity with average gross revenues for the preceding three years not exceeding \$55 million, and a very small business as an entity with average gross revenues for the preceding three years not exceeding \$20 million. Consistent with the decision in the *Competitive Bidding Update Report & Order*, we also seek comment on whether the unique characteristics of these frequencies and our proposed licensing model suggest that we should adopt different small business size standards and associated bidding credits than we have in the past. We seek comment on these issues, including the costs and benefits associated with different approaches we might take.

250. Commenters should focus on the appropriate definitions of small businesses and very small businesses as they may relate to the size of the geographic area to be served and the spectrum allocated to each license. Further, commenters should discuss and quantify any costs or benefits associated with these standards and associated bidding credits as they relate to the proposed geographic areas. In discussing these issues, commenters are requested to address and quantify the expected capital requirements for services in these bands and other characteristics of the service. Commenters are also invited to use comparisons with other frequency bands for which the Commission has already established service rules as a basis for their comments and any quantification of costs and benefits regarding the appropriate small business size standards.

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<sup>422</sup> *Competitive Bidding Update Report & Order*, 30 FCC Rcd at 7521 ¶ 65; *Part 1 Third Report and Order*, 13 FCC Rcd at 388 ¶ 18; 47 C.F.R. § 1.2110(c)(1).

<sup>423</sup> *Competitive Bidding Update Report & Order*, 30 FCC Rcd at 7524 ¶ 74.

<sup>424</sup> See, e.g., Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands, WT Docket No. 02-353, *Report and Order*, 18 FCC Rcd 25162, 25220 ¶ 149 (2003). See also *AWS-4 Service Rules R&O*, 27 FCC Rcd at 16185 ¶ 217 (adopting the AWS-1 size standards and associated bidding credits for small businesses for any AWS-4 licenses awarded through competitive bidding); Service Rules for Advanced Wireless Services H Block — Implementing Section 6401 of the Middle Class Tax Relief and Job Creation Act of 2012 Related to the 1915-1920 MHz and 1995-2000 MHz Bands, WT Docket No. 12-357, *Report and Order*, 28 FCC Rcd 9483, 9581 ¶ 262 (2013) (adopting the AWS-1 size standards and associated bidding credits for small businesses for any H Block licenses awarded through competitive bidding). See also Amendment of Parts 1, 21, 73, 74, and 101 of the Commission’s Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands, WT Docket No. 03-66, *Third Order on Reconsideration and Sixth Memorandum Opinion and Order and Fourth Memorandum Opinion and Order and Second Further Notice of Proposed Rulemaking and Declaratory Ruling*, 23 FCC Rcd 5992, 6007 ¶¶ 27-28 (2008).

<sup>425</sup> Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands, *Notice of Proposed Rulemaking*, WT Docket No. 02-353, 17 FCC Rcd 24135, 24164 ¶ 76 (2002).

251. In establishing the criteria for small business bidding credits, we acknowledge the difficulty in accurately predicting the technology and market conditions that will exist at the time these frequencies are licensed. Thus, our forecasts of types of services that will be offered over these bands may require adjustment depending upon ongoing technological developments and changes in market conditions.

**c. Rural Service Provider Provisions for Geographic Area Licenses**

252. *Background.* In the *Competitive Bidding Update Report & Order*, the Commission adopted a 15 percent bidding credit for eligible rural service providers. The new rural service bidding credit allows an eligible rural service provider that provides commercial communications services to a customer base of fewer than 250,000 combined wireless, wireline, broadband, and cable subscribers and serves primarily rural areas a 15 percent bidding credit.<sup>426</sup> An applicant is permitted to claim a rural service provider bidding credit or a small business bidding credit, but not both.<sup>427</sup> The rural service provider bidding credit is designed to better enable rural service providers to compete for spectrum licenses, thereby speeding the availability of wireless voice and broadband services in rural areas, in furtherance of statutory objectives.<sup>428</sup>

253. *Discussion.* We seek comment on whether it is appropriate to apply the rural service provider bidding credit to auction of the 28 GHz, 37 GHz, and 39 GHz. While the rural service provider bidding credit is new, we have used other types of bidding credits in the past to facilitate competition for spectrum at auction. Given the nature of the services being contemplated for the mmW bands, is use of the rural service provider bidding credit appropriate? Commenters are requested to address and quantify the expected capital requirements for service in rural areas and other characteristics of the service when provided in rural areas.

254. We note that under our Part 1 rules, a winning bidder for a market will be eligible to receive a bidding credit for serving a qualifying Tribal land within that market, provided that it complies with the applicable competitive bidding rules.<sup>429</sup>

**d. Bidding Process Options**

255. We seek comment on whether we should revise any of our bidding process and payment rules to take into consideration the administrative difficulties for the Commission in enforcing construction requirements in the 3,143 counties nationwide. One alternative means of encouraging deployment of network facilities and spectrum utilization (in place of traditional construction requirements), as discussed above, would be to allow potential licensees to bid, in a single auction, on licenses that have consecutive terms of license rights in a given geographic area. Under this concept, at an auction the licensee would be bidding for the right to obtain the license not only for the first license term, but at each consecutive license term, for a fixed price (which could be adjusted for inflation in successive license terms). We note that, if we were to adopt such a proposal, we would likely adopt a shorter license term than ten years, such as five years because a shorter license term would enable us to ensure that the licensee evaluates its need for the spectrum on a regular basis. For example, prospective millimeter wave licensees could bid for a license in a given county in a single, one-time auction, and the winning bidder in that auction would be required to pay the auction price, adjusted for inflation, before the start of each five-year license term; once the winning bidding made this payment before a five-year

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<sup>426</sup> See *Competitive Bidding Update Report & Order*, 30 FCC Rcd at 7530-7531 ¶ 88.

<sup>427</sup> *Id.*

<sup>428</sup> *Id.*

<sup>429</sup> 47 C.F.R. § 1.2110(f)(3). The Commission also currently has under consideration various provisions and policies intended to promote greater use of spectrum over Tribal lands. Improving Communications Services for Native Nations by Promoting Greater Utilization of Spectrum over Tribal Lands, WT Docket 11-40, *Notice of Proposed Rulemaking*, 26 FCC Rcd 2623, 2630-2631 ¶¶ 19-20 (2011) (*Tribal Lands NPRM*).

license term, a new license would be issued to the licensee for that five-year term. Additionally, licensees could be permitted to trade future license rights via secondary market transactions.

256. This concept could be one way to incentivize deployment for a diverse range of uses in the public interest and discourage spectrum warehousing, without imposing traditional performance requirements. We do not believe the consecutive payments would not be installment payments because the license for a term would not issue until after each payment—which had been determined in the auction—had been made for that term. Thus, the license would terminate automatically if the payment was not made. We seek comment on this concept, including its costs and benefits. In the alternative, we seek comment on whether we should accomplish the same goal by levying license fees in consecutive intervals in lieu of performance requirements, which may not be well suited for the types of deployments contemplated in this band. Could economic performance serve as a legally viable substitute for traditional build out or service-based performance requirements? Would this framework encourage or discourage hoarding of Upper Microwave Flexible Use Service licenses? Would the use of delayed payments for successive terms, in practice, lead to complications similar to those experienced in the past with installment payments? Is the Commission's existing legal authority sufficient to permit it to adopt auction and payment rules to implement this approach? Are there any statutory or other legal considerations that the Commission should consider in revising its existing payment, application and default rules to accommodate the re-auction proposal?

257. We seek comment, with respect to this proposal, on whether we should revise any of our payment rules to take into consideration the potential for applicants to become winning bidders for licenses that do not become effective until five years or more after the auction has closed. For instance, under this proposal, should we revise our upfront payment requirement to better safeguard the Commission against defaults by a winning bidder on consecutive license terms? Should we require a winning bidder for consecutive license terms to make a larger down payment to better safeguard the Commission from defaults in subsequent terms? Currently, unless otherwise noted by public notice, the Commission's rules require that within 10 business days after being notified that it is a high bidder on a particular license the winning bidder must submit its down payment necessary to bring its total deposits up to twenty (20) percent of its winning bid(s) or it will be deemed to have defaulted.<sup>430</sup> Should we increase the down payment percentage here to be forty percent of the winning bid(s)? Similarly, unless otherwise specified by public notice, auction winners are required to pay the balance of their winning bids in a lump sum within ten business days following the release of a public notice establishing the payment deadline.<sup>431</sup> Here, we could collect the down payment required for each Upper Microwave Flexible Use Service license at the close of the auction, including consecutive term licenses, but final payment(s) would not be due until we are ready to grant the particular Upper Microwave Flexible Use Service license at the beginning of the subsequent license term. Will retaining down payments on deposit for consecutive Upper Microwave Flexible Use Service license terms, particularly if the down payment obligation for such a license is increased, help the Commission safeguard against the potential of default in subsequent years?

258. We also seek comment on whether we should revise our default rule to ensure that if a winning bidder wins a Upper Microwave Flexible Use Service license in a licensing area for consecutive terms and defaults on a payment obligation for a license in that area, it loses the right it acquired at the auction to be granted a Upper Microwave Flexible Use Service license in that area for any consecutive term? What incentives would be created by such a default provision, and would those incentives help to ensure that the spectrum was used productively? In situations where the Commission has determined that a bidder's default might have a greater potential to detrimentally impact the integrity of an auction, it has adopted a higher default percentage to serve as deterrent against such an outcome.<sup>432</sup> If we hold an

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<sup>430</sup> 47 C.F.R. § 1.2107.

<sup>431</sup> 47 C.F.R. § 1.2109.

<sup>432</sup> 47 C.F.R. § 1.2104(g)(2)(ii).

auction that offers Upper Microwave Flexible Use Service licenses for consecutive terms, should we also change the default rule by holding a winning bidder for such licenses who defaults on its winning bids responsible for a larger default payment? What percentage of the defaulted bid should be assessed as the additional payment portion of the default payment obligation? Should the amount of the additional payment be greater than the percentage prescribed in our rules for defaults on combinatorial bids?

259. Would such a default rule adequately safeguard the Commission should a winning bidder file bankruptcy between the close of an auction and the date of a future payment obligation? Commenters should address in particular the application of the Bankruptcy Code's requirement that an agency "may not deny, revoke, suspend, or refuse to renew a license . . . or other similar grant to," or "discriminate with respect to such a grant against," a debtor or a bankrupt "solely because" it "has not paid a debt that is dischargeable" in bankruptcy.<sup>433</sup> Would the Commission be restricted by the bankruptcy laws in its efforts to recover and re-auction spectrum won by a defaulting bidder that had filed for bankruptcy? Would the costs of obtaining a letter of credit be reasonable in light of the expected value of the spectrum? Would a payment bond be equally effective in giving financial security to the Commission and protecting the Commission from a winning bidder's bankruptcy? Could bids be aggregated for purposes of issuing a letter of credit, without jeopardizing the Commission's ability to recover the auction amounts and any reasonable penalty associated from default? Would the benefits of our delayed final payment mechanism outweigh the risks in bankruptcy and the associated costs?

## 11. Examining Security to Maximize Effectiveness

260. We seek comment on the best methods to ensure maximum effectiveness of the use of the mmW bands, cognizant of potential security vulnerabilities in light of the technology and systems that are anticipated to comprise new networks. There are high expectations that these networks will provide capabilities for a tremendous variety of new devices and applications, including traditional cellular services, M2M and Internet of Things (IoT) applications, and mission critical and public safety services, among many others. However, one of the key challenges facing the developers of new services is to support numerous distinctly different possible uses in a secure manner. The security aspect of services using the mmW bands is important to examine at this time for several reasons including: 1) services using these bands can be used to facilitate very dense deployments of wireless communication links to connect a multitude of wireless devices, many of which might not be secured or sufficiently secured, 2) the core network may be based on software-centric, highly programmable core network architectures that continue to face serious security questions that remain unanswered; 3) the ongoing transformation of advanced mobile communication devices into far more powerful devices of connectivity, thereby making them more alluring to hackers and more menacing not only to the devices' owners but also to the global Internet.<sup>434</sup> The implications of these issues require us to better understand the security of future mmW band networks in order to promote public safety through communications networks.

261. Generally, we seek comment on how to ensure that effective security features are built into key design principles for all mmW band communications devices and networks. The common network security triad of confidentiality, integrity, and availability (CIA triad)<sup>435</sup> provides a convenient frame of reference for the Commission to gain insight into the security events targeting communications

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<sup>433</sup> See 11 U.S.C. § 525(a).

<sup>434</sup> The consequences of botnets spreading to 1Gbps, 100Mbps or even 50 Mbps mobile devices can be catastrophic. See Anne Rüste Flø and Audun Jøsang, Consequences of Botnets Spreading to Mobile Devices, Proceedings of the 14th Nordic Conference on Secure IT Systems (NordSec 2009), Oslo, October 2009.

<sup>435</sup> See, e.g., WhatIs.com, *confidentiality, availability and integrity (CIA triad)*, <http://whatis.techtarget.com/definition/Confidentiality-integrity-and-availability-CIA>; see also NSTAC, An Assessment of the Risk to the Cybersecurity of the Public Network, 2014 (noting the importance of providing network security to physical communications network components "which if damaged or manipulated, could degrade the *confidentiality, integrity, and availability* of data transiting the Internet.") (emphasis added).

providers and the network infrastructure in general in order to guide our approach to the security of communications critical infrastructure. With security built into the design of mmW band devices and systems, the opportunity will exist for the creation of a new generation of networks and services that meet these three critical components of a secure system. To that end, our questions below are organized around these three critical security components.

262. *Confidentiality* refers to the protection of data from unauthorized access and disclosure, both while at rest and in transit.<sup>436</sup> What existing or planned methods of authentication in mobile or fixed networks provide sufficient confidentiality under the conditions planned for mmW band networks? Are there any specific uses or characteristics of the spectrum discussed in this proceeding, alone or in conjunction with other bands, that would make it difficult to ensure the confidentiality of users, either in terms of the content or the circumstances (time, place, and manner) of their use? What implications do the proposed uses of these bands have for authentication of users? What, if any, action should the Commission take to ensure that an appropriate level of confidentiality is provided to the content of users communications (e.g., voice, video and data) and to the data generated as part of the communication (usage history, etc.)?

263. *Integrity* refers to the protection against the unauthorized modification or destruction of information.<sup>437</sup> Does the shorter range of communications in these bands and concomitant expected reliance on more access points increase, or decrease the ease of interception and potential compromise of integrity of the communication? What security or architectural methods might mitigate such issues, and are they under consideration by the appropriate standards bodies? What actions could the Commission take to assist industry in developing minimum security standards in order to ensure the integrity of devices that connect to or through other devices using these bands or any other network connection?

264. *Availability* refers to the accessibility and usability of a network upon demand.<sup>438</sup> What conditions should be considered in order to ensure the availability and security of networks utilizing the mmW bands? To what extent will planned capabilities be robust and secure enough to support communication all the time?

265. We seek comment on the extent to which existing and previous wireless protocols do not inherently derive useful security services from the underlying transport layer and how such vulnerabilities could be prevented from propagation into mmW band networks. For example, would spectrum used in these bands to supply common carrier services have similar security requirements to similar services using lower bands, and if not, how do security requirements differ? Would security requirements vary based on the use of the service (i.e., voice or data), and if so, how? We seek comment on whether the protocols established for these bands might include elements specifically designed to provide security value for higher layers of the OSI Model.<sup>439</sup> Would some of these attributes be more meaningful for enterprise use, or for personal use?

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<sup>436</sup> See, e.g., ATIS, ATIS Telecom Glossary, <http://www.atis.org/glossary/definition.aspx?id=6609>.

<sup>437</sup> See, e.g., ATIS, ATIS Telecom Glossary, <http://www.atis.org/glossary/definition.aspx?id=4584>.

<sup>438</sup> See, e.g., ATIS, ATIS Telecom Glossary, <http://www.atis.org/glossary/definition.aspx?id=5637>.

<sup>439</sup> The OSI Model is a theoretical model of networks that organizes the network functions into various layers (physical, datalink, network, transport, session, presentation, and application layers) and specifies the communications interfaces between these layers and between network endpoints utilizing an OSI Model-based protocol suite. The International Standards Organization (ISO) developed this model of how networks should behave and how they are put together. The ISO OSI Model is used throughout the network, Internet and telecommunications industries today to describe various networking issues, and can be useful in explaining how various technologies interact, where they reside, what functions they perform, and how each protocol communicates with other protocols. See What is the OSI Model, NETDAEMON.COM, [http://www.inetdaemon.com/tutorials/basic\\_concepts/network\\_models/osi\\_model/what\\_is\\_the\\_osi\\_model.shtml](http://www.inetdaemon.com/tutorials/basic_concepts/network_models/osi_model/what_is_the_osi_model.shtml).

## F. Technical Rules

### 1. Introduction

266. Our goal in establishing technical rules is to develop a flexible set of rules that will authorize as wide a variety of services as possible and avoid mandating specific technologies or deployment models. We recognize that the technology is still in early stages of development, and intend to create a set of technical rules that encourage, rather than inhibit that development. We also recognize that we may need to be nimble and flexible as the technology develops, and update our rules as appropriate.

267. A common theme among the comments and replies that we received in response to the *NOI* was that the Commission should consider a “light” regulatory approach in the development of technical rules so that new wireless technologies might flourish. Thus, for example, Wireless Innovation Forum acknowledges that the Commission mandated a specific technology for 1G cellular but says that the Commission has followed a more successful policy since 1987: limiting its regulations for new commercial mobile radio services to interference-related technical criteria, allowing the rapid evolution from 2G to 3G to 4G to proceed without any requirement for new rules to mandate the details of transmitted waveforms.<sup>440</sup> AT&T recalls the 13-year wait that followed its proposal to initiate the first generation of cellular service,<sup>441</sup> a delay that it claims is attributable in part to the Commission’s over-involvement in mandating the specific details of 1G wireless service. NYU Wireless, which has conducted extensive field trials of mmW mobile propagation equipment, recommends that the Commission focus on ameliorating RF safety issues and preventing interference between users.<sup>442</sup> EchoStar similarly urges the Commission to adhere to its longstanding policy of technological neutrality.<sup>443</sup> In commenting on our proposed technical rules, we encourage commenters to keep that principle in mind. If commenters believe our proposed rules are inconsistent with the goal of technical flexibility, we ask them to explain their belief and suggest alternatives.

### 2. Flexible Duplexing Rules

268. Many commenters responding to the *NOI* emphasize that mmW technology is in an early stage of development and request that the Commission consider a flexible regulatory regime in order to provide maximum flexibility. Qualcomm states that “the types of services supported in these bands may be asymmetric, such as user streaming and downloading of audiovisual content, and thus benefit from the flexibility that Time Division Duplex (TDD) operation provides. Additional potential benefits of TDD include exploiting reciprocity for beamforming and supporting dynamic resource matching to traffic.”<sup>444</sup> Motorola states that “TDD modes of operation might be the preferred option, as TDD systems are more accommodating to the use of the adaptive antenna technologies that might be needed in bands above 24 GHz. However, as research in this area is still ongoing, the Commission should look for bands that could support both FDD and TDD systems.”<sup>445</sup> Nokia states that “While TDD is a good candidate for 5G millimeter wave systems (mmW), at this early stage of 5G research, the Commission should not mandate TDD for mmW systems, but should leave the door open to FDD and other new types of duplexing that may be available in the future.”<sup>446</sup>

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<sup>440</sup> The Wireless Innovation Forum Comments at 5.

<sup>441</sup> See AT&T Reply Comments at 2-5.

<sup>442</sup> NYU Wireless Comments at 43.

<sup>443</sup> EchoStar Comments at 11.

<sup>444</sup> Qualcomm Comments at 12-13.

<sup>445</sup> Motorola Comments at 7.

<sup>446</sup> Nokia Reply Comments at 6.

269. We agree with commenters that there is no need to mandate a duplexing option at this stage of mmW technology research and development. In addition, we would prefer to avoid adopting any rules that would preclude the development of new forms of duplexing that further technological advances might introduce.<sup>447</sup> For those reasons, we propose to adopt flexible use in 27.5-28.35 GHz band, 37-38.6 GHz band, and 38.6-40 GHz band by allowing TDD and FDD deployment subject to other relevant technical rules to manage the interference.

270. In the 39 GHz band, we previously proposed above<sup>448</sup> to continue using the existing 39 GHz channel plan. The 39 GHz band is subdivided into 14 channel pairs. Each channel pair has 50 megahertz by 50 megahertz of spectrum and is licensed on an Economic Area geographical service area basis.<sup>449</sup> The existing band plan was created to support traditional fixed point-to-point and point-to-multipoint wireless services. Our current rules do not prescribe or preclude either FDD or TDD based wireless operations, however, paired 50 MHz channels in the band plan naturally imply FDD operations. Most commenters agree that the technologies proposed for mobile mmW, at a minimum, will need at least 100 MHz of contiguous spectrum.<sup>450</sup> Some commenters even suggested the need for up to 2GHz of contiguous bandwidth. We seek comment on the impact of the current channel plan, which may favor FDD operations, on the ability to deploy future mmW wireless networks that might deploy either FDD or TDD based technologies. Should we consider alternate band plans in order to accommodate TDD operations, and if so, how should we modify our proposals to accommodate such band plans?

### 3. Transmission Power Limits and Antenna Height

#### a. Base Stations

271. Currently, the Part 101 rules allow a maximum EIRP of +55dBW (or +85dBm) for the 28 GHz band and the 39 GHz band order to provide flexible fixed services for various applications.<sup>451</sup> Existing service providers in the 28 and 39 GHz bands generally use those bands for establishing fixed point-to-point or point-to-multipoint high capacity communication links. A fixed transmitter typically includes a high-gain antenna mounted at a high tower elevation in order to provide a line-of-sight path to the receiving antenna. The range of these communication links often extends to several miles when the maximum allowed transmission power is used. We propose that we maintain the existing EIRP limit of +55dBW (or +85dBm) solely for fixed point-to-point or point-to-multipoint systems. This limit would allow continued operation of current or future fixed point-to-point or point-to-multipoint systems that are operating consistent with the current Part 101 rules, and we are not aware of any problems with the existing limit for fixed operations.

272. In response to the *Notice of Inquiry*, most commenters envision mmW band Mobile Services as supplementing existing 3G/4G services by overlaying their comparatively large cells with deployment of small cell-like equipment, with service radii of a few hundred meters. Qualcomm states that “cellular networks will use millimeter band spectrum as a supplementary component within an architecture that is anchored in lower-band spectrum because of the highly favorable propagation characteristics of sub-5 GHz spectrum.”<sup>452</sup> Intel states, “We anticipate the cell size of the resulting mmW

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<sup>447</sup> See, e.g., Steven Hong *et al.*, *Applications of Self-Interference Cancellation in 5G and Beyond*, IEEE Communications Magazine, February 2014 at 114 *et seq.* (application of self-interference cancellation technology to terrestrial operations could make “any-division duplexing” possible).

<sup>448</sup> See ¶ 117, *supra*.

<sup>449</sup> See 47 C.F.R. § 101.147(v)(1).

<sup>450</sup> See ¶ 16, *supra*.

<sup>451</sup> See 47 C.F.R. § 101.113.

<sup>452</sup> Qualcomm Comments at 11.

technology to be relatively small, and lie between 100-200m in outdoor deployments.<sup>453</sup> Samsung states that, “In the initial phase, millimeter wave small cells would be rolled out on top of the existing network to form an overlay network architecture. The existing macrocell layer would provide coverage, while the millimeter wave small cell layer would provide capacity.”<sup>454</sup>

273. Commenters suggest a maximum transmission power limit of 58-65 dBm EIRP for base stations. Intel states that “58 dBm (631 watts) EIRP for base station transmitters . . . could achieve the performance and range for the applications targeted for these bands.”<sup>455</sup> Samsung states that, in its field trials, “Based on a 58 dBm EIRP limit, satisfactory communications links were attained even in non-line-of-sight scenarios more than 200 meters away.”<sup>456</sup> Straight Path states that “the FCC [should] adopt an EIRP limit of 65 dBm (3160 watts) for base stations operating in the 39 GHz and LMDS bands. This is consistent with the maximum power limit for other spectrum in which mobile services operate – e.g., the Cellular, Broadband PCS, WCS, AWS, and 700 MHz bands.”<sup>457</sup> Furthermore, most commenters are proposing to build systems with emission bandwidth greater than 100 megahertz. Samsung and Motorola suggest 100 megahertz of channel bandwidth, while Nokia and NYU propose a minimum bandwidth of 300 megahertz and 500 megahertz. TIA and Huawei state that 1-2 gigahertz of spectrum may be aggregated to provide gigabit throughput.<sup>458</sup>

274. Based on the proposed deployment and service scenarios of mmW mobile broadband service, we conclude that the transmission power limits of Mobile Services in PCS and AWS bands are more applicable than the Part 101 FS rules as potential models for the mmW mobile broadband service.<sup>459</sup> Therefore, we propose to adopt 1640 watts (or 62dBm) EIRP as the maximum transmission power limit for base stations operating in the 28, 39, and 37 GHz bands.

275. In a number of recent proceedings, the Commission has applied the power spectral density concept when adopting transmission power limits. For example, base stations operating in the PCS, AWS-1, AWS-3, AWS-4 and 700 MHz bands are allowed to operate at maximum power when transmitting with an emission bandwidth of 1 megahertz or less and may scale the transmission power linearly per 1 megahertz with an emission bandwidth greater than 1 megahertz. For base stations operating in the 28, 39, and 37 GHz bands, we propose to adopt 100 megahertz as the scaling factor such that the base station transmission power is limit to 1640 watts EIRP, when transmitting with less than 100 megahertz of emission bandwidth and 1640 watts EIRP per 100 megahertz when transmitting with more than 100 megahertz of emission bandwidth.<sup>460</sup> This proposed rule would allow additional transmission power for systems employing more than 100 megahertz emission bandwidth, and it would support the maximum transmission power limits suggested by commenters.<sup>461</sup> We also propose to adopt the practice

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<sup>453</sup> Intel Comments at 7.

<sup>454</sup> Samsung Comments at 25.

<sup>455</sup> Intel Ex-parte, “Recommendations on the Use of Spectrum Bands Above 24 GHz for Mobile Radio Services”, GN Docket No. 14-177 (filed Aug. 10, 2015) at 18.

<sup>456</sup> Samsung Comments at 28.

<sup>457</sup> Straight Path Comments at 11.

<sup>458</sup> Samsung Comments at 51, Motorola Comments at 6, NYU Comments at 56, Nokia comments at 27, TIA comments at 3, Huawei Comments at 13-14.

<sup>459</sup> Base stations for PCS, 700 MHz, and AWS are limited to 1640 watts/MHz EIRP with an emission bandwidth greater than 1 MHz. WCS base stations are limited to 2000 watts EIRP. See 47 C.F.R. §§ 24.232(h)(1), 27.50.

<sup>460</sup> We propose to scale the transmit power linearly for transmit bandwidths that are not exactly multiples of hundred megahertz.

of doubling transmission power limits in rural counties where the population density is 100 or fewer persons per square mile, based on the most recently available population statistics from the Bureau of the Census. We seek comment on these proposed transmission power limit rules.

276. Some commenters suggest that in-band backhaul might be feasible in the mmW bands by dedicating certain portion of array antennas of 5G system for backhaul use or allocating certain portion of timeslots of TDD 5G system for backhaul use. InterDigital states, “In the frequency bands discussed in this NOI (24 GHz and above), large swaths of bandwidth are available; to make efficient use of this spectrum, the regulatory framework needs to be enhanced to enable the use of both access and backhaul technologies.”<sup>462</sup> Ericsson states, “For mobile broadband systems offering access in the mmW bands, sharing the same frequencies between access and backhaul appears attractive. Highly directive transmission at mmW frequencies provides good spatial separation between transmissions and can thus be seen as an enabler for access and backhauling sharing the same frequencies.”<sup>463</sup> Recently, the Commission modified 60GHz rules to allow a peak EIRP limit of 85 dBm with very high gain antennas to support outdoor point-to-point backhaul service.<sup>464</sup> We seek comment on whether a higher transmission power limit should be considered for the in-band application where the same equipment is used to for mobile service and backhaul service.

277. Our PCS and AWS rules require reduction of the transmission power limit when the antenna height is more than 305 meters (or 1000 feet).<sup>465</sup> The purpose of those rules is to mitigate the risk of harmful interference from high-elevation transmitters to neighboring services in adjacent markets. We seek comment on whether a similar antenna height limit should be applied to the base stations operating in the proposed bands. Should we allow increased antenna heights in rural areas? We request that commenters provide technical analyses to justify their proposals.

#### **b. Mobile Stations**

278. Commenters propose a wide range of mobile station transmission power limits in response to the *NOI*. Nokia states that “at this time we are assuming approximately +30dBm EIRP for mobile units which can serve as an initial guidance to the Commission.”<sup>466</sup> Intel states that 34dBm, including 9dBi of array gain with 8 elements, for mobile devices could achieve the performance and range for the applications targeted for these bands.<sup>467</sup> Straight Path recommends that “for mobile station, the FCC should adopt a 30dBm maximum output power and 43 dBm maximum peak EIRP.”<sup>468</sup> Samsung recommends 85dBm for 5G mobile stations operating in the 28 GHz band, which is the current transmission limit for base stations operating in the LMDS band.<sup>469</sup>

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<sup>461</sup> Straight Path has proposed 65 dBm for a 500 megahertz channel bandwidth, which translates to 58 dBm (or 631 watts) per 100 megahertz of bandwidth. See Letter from Jerry Pi, Chief Technical Officer, Straight Path Communications, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission (filed Aug. 5, 2015) (Straight Path Aug. 5 *Ex Parte*) at 6 and Appendix B.

<sup>462</sup> InterDigital Comments at 4.

<sup>463</sup> Ericsson Comments at 34.

<sup>464</sup> See 47 C.F.R. § 15.255(b)(1)(ii). The rules requires the transmit power limit to be reduced by 2dB for every dB that the antenna gain is below 51 dBi.

<sup>465</sup> See 47 C.F.R. §§ 24.232, Tables 1 and 2, 27.50 Tables 1-4.

<sup>466</sup> Nokia Comments at 24.

<sup>467</sup> Intel *Ex Parte* at 18.

<sup>468</sup> Straight Path Comments at 12.

<sup>469</sup> Samsung Comment at 35.

279. We are tentatively inclined to accept Straight Path's recommendation that, for mobile transmitters in the 28, 39, and 37 GHz bands, we should adopt the same maximum peak EIRP limit of 43 dBm (20 watts) that is already allowed in the 57-64 GHz band under the current Part 15 rules.<sup>470</sup> As discussed in further detail below,<sup>471</sup> all radiofrequency devices are subject to the radiofrequency radiation exposure specifications in sections 1.1307(b), 2.1091 and 2.1093 of the Commission's rules. When the 57-64 GHz rules were adopted in 1995,<sup>472</sup> most of the products envisioned for that band were not handheld devices, and the higher transmission power was granted to support future technologies that were expected at that time.<sup>473</sup> In practice, most of the Part 15 devices presently reaching consumers for operation in 57-64 GHz band are generally expected to be used at least 20 centimeters away from the user's body and are therefore subject to the requirements in section 2.1091 of the rules.<sup>474</sup> Handheld and other portable user equipment operating in close proximity to users will likely have to operate at lower power in order to comply with the limits specified in section 2.1093 for devices which are likely to be used within 20 centimeters of the user's body under. A device operating at a lower power level to satisfy exposure limits will likely comply with the proposed maximum peak EIRP limit. Thus, we propose that the same maximum peak EIRP limits would apply in any case so long as the exposure limits are met, and a reduction or separate categorization of maximum peak EIRP for different types of devices depending on normal use is unnecessary and redundant with the requirements in sections 2.1091 and 2.1093 of the Commission's rules. We maintain that the requirements applicable to equipment operating in the 28, 39, and 37 GHz bands to demonstrate compliance with the Commission's exposure limits will depend on the normally maintained separation distance from a user's body. The combined effect of those rules and a maximum peak EIRP limit of 43 dBm would be to ensure compliance with the exposure limits while allowing industry flexibility to develop higher-powered transmitters for situations where an appropriate separation distance is maintained.<sup>475</sup> We seek comment on this tentative conclusion and invite alternative proposals.

#### 4. Emission Limits

280. *Background.* Rule 101.111(a)(2)(iv) establishes an emission limit for fixed stations operating in the 28 GHz band expressed as  $A=11+4*(P-50)+10\log_{10}B$ , where A is attenuation below the mean output power of the transmitter, B is the authorized bandwidth in megahertz (40 megahertz for the LMDS band), and P is the percentage by which the transmitter bandwidth is removed from the carrier frequency. This emission limit is defined in conducted fashion. For fixed stations operating in the 39 GHz band, there are several rule sections that apply to emission limitations according to the type of digital modulation techniques deployed.<sup>476</sup> These rules are created to support various fixed microwave technologies with conventional antenna systems, and the emission limits are defined as conducted. .

<sup>470</sup> See 47 C.F.R. § 15.15.255(b)(1)(i), which provides an indoor or outdoor peak power emission limit of 43 dBm.

<sup>471</sup> See ¶ 321, *infra*.

<sup>472</sup> See Amendment of Parts 2, 15 and 97 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications, *First Report and Order and Second Notice of Proposed Rule Making*, 11 FCC Rcd 4481, 4496 (1995).

<sup>473</sup> Examples of 57-64 GHz products include Wireless HDMI and IEEE 802.11ad (WiGig) capable laptops.

<sup>474</sup> See equipment authorization test report of a Wireless HDMI device, [https://apps.fcc.gov/oetcf/eas/reports/ViewExhibitReport.cfm?mode=Exhibits&RequestTimeout=500&calledFromFrame=N&application\\_id=py2ovDsoT%2F%2Btu7s3lBkkg%3D%3D&fcc\\_id=HLZMWIT1](https://apps.fcc.gov/oetcf/eas/reports/ViewExhibitReport.cfm?mode=Exhibits&RequestTimeout=500&calledFromFrame=N&application_id=py2ovDsoT%2F%2Btu7s3lBkkg%3D%3D&fcc_id=HLZMWIT1).

<sup>475</sup> This outcome would be consistent with Intel's argument that higher power limits would be appropriate for fronthaul and backhaul operations in the affected bands, but it would not necessarily be inconsistent with Nokia's stated assumption that mobile units will operate at a maximum +30 dBm EIRP, if that assumption were applied only to handheld units. See Intel Comments at 34 and Nokia Comments at 24.

<sup>476</sup> See 47 C.F.R. §§ 101.111(a)(1), (a)(2)(ii), (a)(2)(iii).

281. For most mobile systems, the Commission has generally required licensees to attenuate their unwanted emission power below the transmission power (P) by a factor of at least  $43 + 10\log_{10}(P)$ , or -13 dBm for any emissions on frequencies outside the licensee's authorized spectrum.<sup>477</sup> These requirements take effect at the edges of the assigned frequencies (e.g., channel, block or band), and may be used as a basis for developing further requirements that relate to transmitter performance by industry standard organizations. This limit is applied equally both to base stations and to mobile stations,<sup>478</sup> and compliance with this limit in existing systems, where access to the RF port of the antennas is conveniently available, is based on conducted measurement of transmission power at the output of the individual RF port. In the *NOI*, the Commission sought comment on whether a limit of  $43 + 10\log_{10}(P)$  might be appropriate for mobile broadband systems in the proposed mmW bands.

282. In response to the *NOI*, some commenters express reservations about specifying an out-of-band emissions (OOBE) limit at this early stage of technology development. Motorola expresses the view that “[t]he Commission should not define OOBE and transmit power requirements before the technology has sufficiently evolved.”<sup>479</sup> Ericsson states, “The Commission should seek further input from the mobile industry on the best approach to specifying OOBE and regulation on general emission requirements for multiantenna systems.”<sup>480</sup> Several commenters agree that an OOBE limit of  $43 + 10\log_{10}(P)$  for base stations would be appropriate. Nokia states, “The Commission’s proposed attenuation of  $43+10\log(P)$  for out-of-band emissions (OOBE) should be appropriate since it should be feasible to obtain such levels without filtering on small chip scale phased arrays.”<sup>481</sup> Intel takes the position that, “On OOBE levels, ... the  $43+10\log(P)$ , currently applied in many bands including those used for AWS systems, is an appropriate default level to be applied to mobile systems in bands above 24 GHz. There is no indication of the need for any tighter limits.”<sup>482</sup>

283. *Measurement Challenges.* Some commenters indicate that conducted measurement of OOBE can be challenging. Ericsson states, “Assuming a tight integration of the radio front ends with the antenna array, there will most likely not be any physical test points available or even feasible for conducted testing of emissions, but it would need to be tested using over-the-air (‘OTA’) testing. It would therefore be beneficial to also have the emission requirements defined as a radiated requirement. Moreover, requiring a conducted test would require the introduction of physical test points or test connectors, which would be both costly and bulky.”<sup>483</sup> Straight Path states, “The technology trend is to

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<sup>477</sup> For bands over 1 GHz, for example PCS and AWS-1, the Commission has typically set the OOBE limit at 43 dBW/MHz (13 dBm/MHz). See 47 C.F.R. § 24.238, 27.53(h). For bands under 1 GHz, for example Cellular and 700 MHz, the limit is typically -13 dBm/100 kHz. See 47 C.F.R. § 22.91, 27.53(c). These general limits, intended to mitigate the risk of harmful interference to operations by adjacent users, are consistent with the ITU-R recommendation that most transmitters spurious emissions should be attenuated by a factor of at least  $43 + 10\log_{10}(P)$  dB in 100 kilohertz for frequencies between 30 MHz and 1 GHz, and  $43 + 10\log_{10}(P)$  dB in 1 megahertz for frequencies for above 1 GHz. See Recommendation ITU-R SM.329-12 (09/2012) Unwanted emissions in the spurious domain at 7-8, available at [http://www.itu.int/dms\\_pubrec/itu-r/rec/sm/R-REC-SM.329-12-201209-I!!PDF-E.pdf](http://www.itu.int/dms_pubrec/itu-r/rec/sm/R-REC-SM.329-12-201209-I!!PDF-E.pdf).

<sup>478</sup> Most cellular, PCS, and AWS outdoor base stations have 15-18dBi of antenna gain, raising the effective radiated emission limit but most handheld devices have effectively zero antenna gain.

<sup>479</sup> Motorola Comments at 8.

<sup>480</sup> Ericsson Comments at 34.

<sup>481</sup> Nokia Comments at 24.

<sup>482</sup> Intel Comments at 34.

<sup>483</sup> Ericsson Comments at 33.

integrate antenna arrays with power amplifiers on the same printed circuit board – or even on the same chip package or integrated circuit – which can make the measurement procedure difficult.”<sup>484</sup>

284. *Discussion.* We acknowledge the measurement challenges identified by commenters and discussed in the Equipment Authorization section, and in response we propose to define emission limits in radiated fashion.<sup>485</sup> Commenters suggest that the 5G base stations in mmW bands are expected to employ more than 100 radiating elements to effectively create multiple beams to serve multiple simultaneous users in a given cell. For example, Intel states, “We anticipate support for multiple beams, permitting simultaneous access to multiple users. The number of users simultaneously supported will depend on the class of base station.”<sup>486</sup> Ericsson states, “Ericsson is currently working with IBM on phased-array antenna solutions that would put a hundred or more antennas and radios on a single chip smaller than a credit card for use in high-capacity small cells in 5G networks.”<sup>487</sup> 5G mobile stations in mmW bands are also expected to have tens of radiating elements with multiple power amplifiers. With lack of RF ports, the emission measurement needs to be made in radiated fashion, and the antenna gain must be characterized and subtracted from the radiated measurement if the emission limit is to be defined in conducted fashion.<sup>488</sup> We tentatively conclude that defining the emission limit in radiated fashion is more practical than alternative methods and seek comment on this proposal.

285. Accordingly, we seek further comment on radiated emission limits for 5G transmitters in mmW bands. We define out-of-band emission and spurious emission as characterizing the overall emission performance of a transmitter<sup>489</sup> and the measurement procedures for spurious emissions at antennal terminals and field strength of spurious radiation are described in the Commission’s rules.<sup>490</sup> For bands higher than 1 GHz, for example PCS and AWS-1, compliance with the emission rule is based on a resolution bandwidth of 1 megahertz or greater, except within the first 1 megahertz. In the first 1 megahertz band immediately outside and adjacent to the channel block, a resolution bandwidth of at least 1 percent of the emission bandwidth of the fundamental emission of the transmitter may be employed, provided that the measured power is integrated over the full required measurement bandwidth.<sup>491</sup>

286. Some commenters suggest that an emission attenuation of  $43+10 \log P$  per MHz (or -13dBm/MHz) in radiated fashion is still achievable at certain frequency offsets from the edge of the transmission signal, while others indicate that the conducted emission limit of  $43+10 \log P$  is achievable but do not specify the resolution bandwidth or the measurement offset. Intel states that a “step-like mask

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<sup>484</sup> Straight Path Comments at 2.

<sup>485</sup> Note that the emission limits for unlicensed devices are traditionally defined in field strength and the radiated measurement is typically taken at a certain distance away from the transmitter. *See* 47 C.F.R. §§ 15.109, 15.209.

<sup>486</sup> Intel Comments at 13-14.

<sup>487</sup> Ericsson Comments at 9-10.

<sup>488</sup> Most mobile services in licensed bands define the emission limit in conducted fashion, where the measurement for determining compliance is done directly at the antenna port. Measuring the emission on a radiated fashion requires that the measurement be made at some point away from the antenna, where the measurement is made on the signal created by the radiated elements and transmitted over the air.

<sup>489</sup> *See* 47 C.F.R. § 2.1. The Commission defines the out-of-band emission as the emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions. Spurious emission is defined as the emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions. These definitions are consistent with the international radio regulations.

<sup>490</sup> *See* 47 C.F.R. §§ 2.1051, 2.1053.

<sup>491</sup> *See* 47 C.F.R. §§ 24.238, 27.53.

cannot meet requirements for 100/200 MHz channels; [m]ask must be gradual up to offset of 50 MHz.”<sup>492</sup> Straight Path states, “The spurious emission limit (emission limit for  $P > 250$ ) ... will mostly be governed by the “ $43 + 10 \text{ Log}_{10}$  (the mean output power in watts) decibels” limit, which is equivalent to -13 dBm/MHz with typical configurations of 5G systems.”<sup>493</sup> We seek comment on whether a radiated emission limit of  $43+10\log(P)$  can be supported by 5G transmitters operating in the 27.5-28.35 GHz, 37-38.6 GHz, and 38.6-40 GHz bands, and if so, what resolution bandwidth and frequency offset should be considered to define out-of-band emissions and spurious emissions. We request that commenters provide technical showings on how the proposed radiated emission limits can mitigate the risk of harmful interference to operations by adjacent users.<sup>494</sup>

287. *Protection of Passive Bands.* As discussed in the “Passive Services Below 37GHz” section above, the 36.43-36.5 GHz band is used for radio astronomy spectral line emissions and all practical steps must be taken to protect radio astronomy in that band from interference. In the same section, we note that the EESS and space research operations are not entitled to interference protection from duly authorized fixed and mobile services in the 36-37 GHz band. Nonetheless, we seek comment on steps we could take to protect those operations without unduly limiting fixed and mobile operations in the 37 GHz band.<sup>495</sup>

288. As commenters propose emission limits for mobile stations and base stations operating in 37-40 GHz band, we ask commenters to provide interference analysis into passive service receivers operating in 36-37 GHz band, including the assumptions on the distance separation, propagation model, system loading, aggregate number of transmitters, antenna characteristics, and others as appropriate.

## 5. Interference Protection and Coordination

### a. Coordination and Field Strength Limits at Market Borders

289. *Background:* The Commission’s rules for mobile services typically define field strength limits at the market boundaries in order to prevent interference between licensees in adjacent markets. For example, Part 27 for AWS specify that the predicted or measured median field strength at any location on the geographical border of a licensee’s service area shall not exceed 47 dB $\mu$ V/m unless the adjacent affected service area licensee(s) agree(s) to a different field strength. Our current rules contain coordination distances for both the 28 GHz and 39 GHz bands under which a fixed terrestrial licensee, within a certain prescribed distance of a mutual GSA border, is required to coordinate with the potentially affected fixed licensee of an adjacent GSA.<sup>496</sup> Straight Path recommends “a PFD limit of -86 dBm/m<sup>2</sup>/MHz or, equivalently, an electric field strength limit of 30 dBuV/m/MHz as the co-channel interference limit at the economic area boundary for 39 GHz mobile services.”<sup>497</sup> Qualcomm believes that it may be premature given the state of technology to establish field strength or power flux density limits at geographic service area borders at this time.<sup>498</sup> Nokia believes that mmW mobile operations will involve advanced networks that will be capable of managing and avoiding interference not only among

<sup>492</sup> See Intel Corporation, Recommendations on the Use of Spectrum Bands Above 24 GHz for Mobile Radio Services (filed Aug. 10, 2015) at 6.

<sup>493</sup> See Letter from Jerry Pi, Chief Technical Officer, Straight Path Communications, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission (filed Aug. 5, 2015) (Straight Path Aug. 5 *Ex Parte*) at 8.

<sup>494</sup> While our proposed rules contain an emission attenuation of  $43+10\log P$  per MHz with the measurement techniques of PCS and AWS bands. We recognize, however, that we need additional information before we can reach any conclusions on the appropriate emission limit.

<sup>495</sup> See Section IV.D.3, *supra*.

<sup>496</sup> See 47 C.F.R. §§ 101.103(g), (i).

<sup>497</sup> Straight Path Aug. 5 *Ex Parte* at 8-9.

<sup>498</sup> Qualcomm Comments at 14.

themselves but also with other licensees and technologies. Their belief in this proposition is coupled with the concept that the advanced narrow beams formed in highly attenuating frequencies will, in and of themselves, provide sufficient interference protection to protect adjacent licensees and differing wireless technologies operating in the spectrum.<sup>499</sup>

290. *Discussion:* We seek comment on the appropriate interference protection criteria. Specifically, is the existing field strength limit of 47 dBuV/m specified in Part 27 appropriate for mmW mobile and fixed services? Is Straight Path's proposed PFD limit of -86 dBm/m<sup>2</sup>/MHz, which incorporates a spectral density more appropriate? Are there alternative more appropriate interference protection limits than these mentioned? Or, are coordination distances, such as those currently specified for the fixed services more appropriate? Additionally we seek comment on alternative, interference limits at the geographical service area border that would protect future mmW operations from unwanted interference. Any such proposed alternative limits should be described in detail and supported by engineering analysis. Commenters who believe that field strength limits at the license boundaries are not necessary should provide specific technical details and analysis substantiating their position that such protections will not be necessary in the future. Additionally we also seek comments as to the applicability of any such interference limit to current or potential future fixed point-to-point terrestrial facilities. Are the Part 27 interference protection technical limits, or alternatively those proposed by Straight Path at the geographic service area border adequate protection criteria for current and potential future fixed point-to-point terrestrial deployments? Are there other proposed interference protection limits that would be more appropriate for protecting fixed services?

291. A worst-case scenario to consider would be a fixed point-to-point terrestrial bi-directional link in one GSA near its border, oriented directly toward an urban area in an adjacent GSA that also lies near the border. Would the Part 27 and Straight Path limits for which we seek comment have more of a limiting effect on fixed point-to-point transmitter deployments than existing rules? Considering the reception antenna in the same scenario, would the Part 27 and Straight Path interference protection limits at the GSA border adequately protect a point-to-point fixed link close to the GSA border that uses narrow-beam, high-gain antennas? Would the protection afforded by the proposed limit be less effective in the protection of fixed point-to-point receivers oriented toward adjacent GSAs near their borders? Considering this worst-case scenario, should the existing rules based on specified distances from adjacent borders be retained, along with the existing coordination requirements? Is there another more appropriate rule that could be applied specifically to current and potential future deployments of fixed point-to-point facilities? Is there a threshold protection level that could be established that benefits the fixed point-to-point facilities as well as future mmW mobile facilities?

292. In a similar fashion, we have considered proposed concepts involving applications where mmW mobile base stations would deploy backhaul and fronthaul "in-band" solutions. These mmW conceptual backhaul/fronthaul uses further support our inquiry as related to the questions posed above because they appear to align closely with the operation of fixed point-to-point facilities. If it is determined that the current rules for fixed point-to-point facilities should be retained, should they be applied to mmW base station backhaul technologies? If so, should we consider retaining the existing distance and coordination requirements with respect to cases where an mmW base station would require "in-band" wireless backhaul? Should these distance requirements be modified and/or made uniform and applied consistently across all the bands? In the converse would the Part 27 and Straight Path interference protection limits allow for these distance requirements that trigger required coordination to become irrelevant in the transition to new rules for these bands?

#### **b. Canadian and Mexican Borders**

293. Sections 101.147(r)(13), 101.509(d), and 27.57 of our rules provide that fixed and mobile operations are subject to international agreements with Mexico and Canada. We propose to apply the

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<sup>499</sup> Nokia Comments at 24.

same limitation to the newly established rule parts for the mmW bands. Until such time as any adjusted agreements between the United States, Mexico, and/or Canada can be agreed to, mmW mobile operations must not cause harmful interference across any of our international borders, consistent with the terms of the agreements currently in force. Currently there are existing Arrangements for the 27.5 – 28.35 GHz LMDS band<sup>500</sup> and 38.6 – 40.0 GHz band<sup>501</sup> between the United States and Canada. We note that further modification of the proposed rules might be necessary in order to comply with any future agreements with Canada and Mexico regarding the use of these bands. We seek comment on this issue, including the costs and benefits of alternatives.

## 6. 37 GHz Technical Rules

294. We seek comment on any changes to our technical rules that may be required if we adopt our proposal to authorize local area operations in the 37 GHz band by rule while issuing geographic area licenses for outdoor use. Are there circumstances under which local area deployments could cause interference to outdoor systems, notwithstanding the heavy signal attenuation in this band? In order to avoid interference, should we propose lower authorized power for local area deployments? What special technical rules, if any, would be needed for indoor systems to promote indoor/outdoor coexistence? For example, do we need to establish a requirement that local area users and geographic area licensees coordinate their proposed operations? If a coordination mechanism is necessary, how should we design that mechanism? If we decide that geographic area licensees should have priority over local area operations, how should we define the responsibilities of the local area licensee to avoid interference? If, on the other hand, we decide that local area operations have priority, are there any special technical rules that would be needed for outdoor operations in this environment? We seek comment on these and other issues relating to the technical rules for our proposed hybrid licensing approach in 37 GHz.

## 7. Interoperability

295. The Commission historically has sought to promote the development of interoperable equipment, allowing smaller providers to benefit from the scale generated by equipment capable of operating across an entire band or adjacent bands. Beginning with the licensing of cellular spectrum, the Commission maintained that consumer equipment should be capable of operating over the entire range of cellular spectrum as a means to “insure full coverage in all markets and compatibility on a nationwide basis.”<sup>502</sup> Since that time, the Commission has addressed the issue of interoperability in several bands,<sup>503</sup> including in the Lower 700 MHz band (where it implemented an industry solution to LTE interoperability),<sup>504</sup> the AWS-3 band (where it mandated interoperability for some operators),<sup>505</sup> and the H

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<sup>500</sup> See <https://transition.fcc.gov/ib/sand/agree/files/can-nb/lmdsagre.pdf>.

<sup>501</sup> See <https://transition.fcc.gov/ib/sand/agree/files/can-nb/24-38fin.pdf>.

<sup>502</sup> Inquiry Into the Use of the Bands 825-845 MHz and 870-890 MHz for Cellular Communications Systems; and Amendment of Parts 2 and 22 of the Commission’s Rules Relative to Cellular Communications Systems, CC Docket No. 79-318, *Report & Order*, 86 FCC 2d 469, 482 (1981). The Commission adopted band-wide interoperability requirements for cellular service. *Id.*

<sup>503</sup> Establishment of Rules and Policies for the Digital Audio Radio Service in the 2310-2360 MHz Frequency Band, *Report and Order [and] Memorandum Opinion and Order and Further Notice of Proposed Rulemaking*, 27 FCC Rcd 5754 ¶¶ 103, 106 (1997); Amendment of the Commission’s Rules to Establish New Personal Communications Services, RM-7140, RM-7175, RM-7618, GEN Docket No. 90-314, *Memorandum Opinion and Order*, 9 FCC Rcd 4957, 5021-5022 ¶¶ 163-64 (1994).

<sup>504</sup> See Promoting Interoperability in the 700 MHz Commercial Spectrum, WT Docket No. 12-69, *Report and Order and Order of Proposed Modification*, 28 FCC Rcd 15122 (2013).

<sup>505</sup> See *AWS-3 R&O*, 29 FCC Rcd at 4698-4699 ¶¶ 229-230.

Block band (where it stressed the importance of interoperability).<sup>506</sup> We continue believe that interoperability delivers important benefits to consumers.

296. We propose to require that mobile equipment operating within each mmW band be interoperable using all air interfaces that the equipment utilizes on the frequencies. Interoperability helps ensure a robust market for equipment, and helps ensure that such equipment is available equally to all licensees. We note that interoperability could be a particularly important issue in the 37 GHz band if we license local area operations and outdoor operations separately. If we take that approach, we believe it would be necessary to ensure interoperability in order to ensure that equipment is available for both types of deployments. We seek comment on this proposal. Are there unique issues implicated in creating interoperable equipment at the frequencies and bandwidths proposed herein? We also seek comment on Straight Path's contention that it should be possible to achieve interoperability between different technologies, *e.g.*, switching between LTE and Wi-Fi.<sup>507</sup>

## 8. Limits on Terrestrial Emissions

297. We seek comment on whether we should adopt emission limits above a certain elevation angle to terrestrial facilities in order to prevent interference between terrestrial facilities and satellites.

298. In the 28 GHz band, there appear to be three situations where terrestrial operators might generate transmissions toward reception antennas on satellites. The first case would involve transmissions from mmW base stations, but comments and research indicate that the most common scenario for such stations would likely include a downward beam-tilt from an antenna situated on a street lamp pole or on a building at a similar height. The second case would involve transmissions from mobile user equipment toward their serving base stations. Those transmissions could be directed upward, but we recognize that any interference to satellites from such user equipment, if it were to occur, would only result from the aggregate power from a very large number of mmW user devices transmitting simultaneously toward the satellite receiver. Noting that comments suggest that mmW user devices are likely to use steerable beamforming antenna arrays the likelihood that a large number of user devices would be pointed at a satellite (while oriented to communicate with a base station) is unlikely. Therefore, such interference appears to be unlikely, but we request any technical analyses that might indicate otherwise, together with any technical limitations that might be required to prevent such interference.

299. Perhaps the most likely increased source of interference to satellites (particularly NGSO satellites) would be the large number of backhaul links that will likely be necessary to connect the many small-cell base stations that will be required to support mobile service in the 28 GHz band. Some commenters envision that future mmW mobile base stations could require a substantial amount of in-band backhaul in order to move traffic from street-level base stations in urban canyons to aggregate backhaul points at higher elevations, using the same 28 GHz spectrum that will be used for mobile access. XO a large holder of LMDS licenses in the 28 GHz band, has stated that it currently has approximately 750 point-to-point-to-point facilities, mainly in urban environments, in most cases serving as an alternative to fiber to connect buildings to telecommunications backbone facilities. It seems reasonable to assume that in the interim and near future, until such time as mmW mobile technologies develop to the point of being commercially viable for deployment, more such facilities proposing technical parameters consistent with the current Part 101 Rules will continue to be built. Taking all three of the above sources of potential interference into account, are the existing and proposed power and emission limits for terrestrial operations in the 28 GHz band sufficient to prevent interference into satellite receivers? We request comments and technical information that would assist us in determining whether it would be necessary or beneficial to limit skyward emissions from terrestrial mmW facilities in the 28 GHz band, and, if so, at what thresholds.

<sup>506</sup> *H Block R&O*, 28 FCC Red at 9498 ¶ 32.

<sup>507</sup> Straight Path Comments at 3.

## 9. Technical Rules for Part 15 Operation within the 64-71 GHz Band

300. We propose to allow unlicensed operations in the 64-71 GHz frequency band pursuant to the same technical rules as in the 57-64 GHz frequency band under section 15.255 of our rules, with slight modifications.<sup>508</sup> We believe that making available a 14-gigahertz segment of contiguous spectrum in these frequencies will encourage the development of very high-speed wireless links with higher connectivity, bandwidth and throughput between small cell sites to support spectral efficiency in existing communications systems as well as in future 5G systems, consistent with the Commission's objectives to bring broadband access to every American and to provide additional competition in the broadband market.

301. Part 15 of the Commission's regulations permits the operation of radio frequency (RF) devices without an individual license from the Commission or the need for frequency coordination.<sup>509</sup> The technical standards contained in Part 15 are designed to ensure that there is a low probability that such devices will cause harmful interference to other users of the radio spectrum.<sup>510</sup> Unlicensed operations within the 57-64 GHz band are currently permitted under section 15.255 of our rules.<sup>511</sup> Any type of unlicensed operation within the 57-64 GHz band is permitted under these rules, with the exception of operation on board aircrafts or satellites, and in mobile field disturbance sensor applications.

302. As indicated above, in the *Spectrum Frontiers NOI*, the Commission sought comment on the potential for the provision of mobile radio services in bands above 24 GHz, and in particular, on the advisability of amending its rules to allow unlicensed Part 15 operations in the 64-71 GHz band segment.<sup>512</sup> Commenters unanimously support this action<sup>513</sup> and recommend that the Commission proceed with extending the band to cover 57 to 71 GHz under the same Part 15 provisions that allow operation in the currently authorized 57-64 GHz band.<sup>514</sup>

303. *Suitability of the Existing Rules in section 15.255 to the 64-71 GHz Band.* We are proposing to extend the technical requirements in section 15.255 to encompass the 57-71 GHz band. As we discuss in detail below, we believe that the existing technical rules in the 57-64 GHz band can successfully apply to the proposed 64-71 GHz adjacent band, with certain minor adjustments. In addition, we seek comment on certain aspects of the rules to further the growth and development of these devices

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<sup>508</sup> 47 C.F.R. § 15.255.

<sup>509</sup> 47 C.F.R. §§ 15.1 *et seq.*

<sup>510</sup> The primary operating conditions under Part 15 are that the operator of a Part 15 device must accept whatever interference is received and must correct whatever harmful interference is caused. Should harmful interference occur, the operator is required to immediately correct the interference problem, even if correction of the problem requires ceasing operation of the Part 15 equipment causing interference. *See* 47 C.F.R. § 15.5.

<sup>511</sup> 47 C.F.R. § 15.255. *See* Amendment of Parts 2, 15, and 97 of the Commission's Rules to Permit Use of Frequencies Above 40 GHz for New Radio Applications, ET Docket No. 94-124, *First Report & Order and Second Notice of Proposed Rulemaking*, 11 FCC Rcd 4481 (1995) (*Above 40 GHz First R&O and Second FNPRM*); *Memorandum Opinion and Order and Fourth Notice of Proposed Rule Making*, 12 FCC Rcd 12212 (1997); *Third Report and Order*, 13 FCC Rcd 15074 (1998) (*Above 40 GHz MO&O and Fourth FNPRM*); Amendment of Part 2 of the Commission's Rules to Allocate Additional Spectrum to the Inter-Satellite, Fixed, and Mobile Services and to Permit Unlicensed Devices to Use Certain Segments in the 50.2-50.4 GHz and 51.4-71.0 GHz Bands, ET Docket No. 99-261, *Report and Order*, 15 FCC Rcd 25264 (2000); Revision of Part 15 of the Commission's Rules Regarding Operation in the 57-64 GHz Band, ET Docket No. 07-113, *Report and Order*, 28 FCC Rcd 12517 (2013).

<sup>512</sup> *NOI*, 29 FCC Rcd at 13042 ¶ 74.

<sup>513</sup> IEEE 802 Comments at 3, Wi-Fi Alliance Comments at 4-7, SiBeam Comments at 3.

<sup>514</sup> IEEE 802 Comments at 3. IEEE 802 further recommends that the Commission create rules for unlicensed operations under Part 15 for frequencies from 71 GHz to 325 GHz. However, we are not considering extending the unlicensed rules in Section 15.255 to these frequencies at this time.

without increasing the potential for harmful interference to authorized users in these bands. We examine the pertinent rules in section 15.255 below.

304. *Operation On Board Aircraft.* Section 15.255(a)(1) prohibits operation of equipment used on aircraft in the 57-64 GHz band. This requirement was adopted in 1995 pursuant to the request of the CORF to protect radio astronomy operations.<sup>515</sup> We now observe that new tri-band chipsets compliant with IEEE Standard 802.11ad<sup>516</sup> and intended for use in future WiGig products may operate in the 2.4 GHz, 5 GHz and 60 GHz bands.<sup>517</sup> These components can be embedded into laptops or other mobile electronic devices used by travelers on airplanes.<sup>518</sup> The present prohibition in our rules would require mobile devices to affirmatively disable Wi-Fi operation at 60 GHz (but not in the 2.4 GHz or 5 GHz frequency ranges) while operating on board a plane, possibly creating difficulty in enforcing compliance.

305. Radio astronomy has no allocations in this 57-64 GHz range; two major radio telescopes (in Green Bank, WV and on Kitt Peak, AZ) operate on an unprotected basis at these frequencies in the continental United States. There are telescopes in Chile, Japan and Europe that regularly operate at these frequencies, and US astronomers are scientific partners with researchers in those facilities. The issue for US radio astronomy about devices operating over the full range of the 57-64 GHz band is whether strong harmonics or out-of-band emission could interfere with observations of the cosmos in the Q-band (40-50 GHz) or W-band (80-96 GHz at all the VLBA sites). While radio signals around 60 GHz attenuate rapidly with distance, attenuation effects due to oxygen become much less pronounced in the 64-71 GHz band and higher, so interference effects propagate over much longer distances. Furthermore, strong harmonic emissions could seriously interfere with radio astronomy observations of the Carbon Monoxide (CO) spectral emission in passive-only bands (protected by ITU-R 5.340 and US246) including 109.5-111.8 GHz, 114.25-116 GHz, 164-167 GHz, 182-185 GHz, and 226-231.5 GHz. Harmonics could also interfere with radio astronomy operations at the 111.8-114.25 GHz, 217-226 GHz, and 241-248 GHz bands.

306. We observe an ongoing industry effort to work with the NTIA and other federal agencies to study compatibility of operation of these new chipsets and their operation on board in-flight aircraft.<sup>519</sup> As such, we believe that the prohibition on operation on board aircraft may be revisited at the present time.<sup>520</sup> We therefore seek comment on this issue. We request technical studies and interference analyses demonstrating whether transmissions in the 57-71 GHz band should be permitted on aircraft. Such operations may include applications in the 57-71 GHz band that support enhancement of in-flight communications service offerings by airlines to meet the increasing consumer demand for broadband connectivity on aircraft. Is it possible to limit unlicensed device operation on aircraft to a narrower portion of the 57-64 GHz band to minimize impact to the radio astronomy observations? If so, should we consider such a limitation?

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<sup>515</sup> See *Above 40 GHz First R&O and Second FNPRM*, 11 FCC Rcd at 4496-4497 ¶ 35. The Commission also stated that “if future filings indicate a need for use of these devices on aircraft and demonstrate how such devices can be designed to avoid potential interference to radio astronomy operations, then we may ultimately allow such use.” *Id.*

<sup>516</sup> 802.11ad is an amendment to the existing IEEE 802.11 standard, which is at the core of billions of Wi-Fi products available worldwide.

<sup>517</sup> See *e.g.*, Intel Comments at 1, stating that “Intel has announced and demonstrated WiGig-based products ... that will be shipping in 2015”; see also, Wilocity WiGig chipset at <http://wilocity.com/resources/Wil6100-Brief.pdf>; *WiGig Certified, Multi-gigabit, Low-latency Connectivity, Coming in 2016*, at <http://www.wi-fi.org/discover-wi-fi/wigig-certified>.

<sup>518</sup> Moreover, certain applications for video sharing between smartphones/laptops and in-flight seat displays are contemplated for operation in the 60 GHz band. See *e.g.*, Zodiac In-flight Innovations at <http://www.imsco-us.com/index.php/products/>.

<sup>519</sup> See <http://www.ntia.doc.gov/page/interdepartment-radio-advisory-committee-irac>.

<sup>520</sup> We are not revisiting the prohibition for operation on board satellites in 47 C.F.R. § 15.255(a)(1) at this time.

307. *Fixed Field Disturbance Sensor Operation.* Section 15.255(a)(2) prohibits operation of field disturbance sensors in the 57-64 GHz band; however it makes an exception for sensors in certain fixed industrial applications (speed control, fluid level, and motion detection functions, etc.)<sup>521</sup> These devices are required to operate at a power level 30 dB lower than communications devices in the 57-64 GHz band, in order to avoid causing harmful interference to co-channel communications devices.<sup>522</sup> Since the rules require these fixed field disturbance sensors to operate at a much lower power than communications equipment in the band, and they have not been the subject of any case of harmful interference over the years, we believe that such devices should be able to co-exist with communications equipment in the proposed 64-71 GHz band without additional harmful interference potential. We seek comment on whether to extend the requirements for these fixed field disturbance sensors in Section 15.255 into the proposed 64-71 GHz band.

308. *Emission Limits.* Except for fixed field disturbance sensors discussed above, section 15.255(b) limits the average power of any emission in this band to 40 dBm EIRP and the peak power to 43 dBm EIRP for transmitters located either indoors or outdoors.<sup>523</sup> In 2013, the Commission modified these rules to provide transmitters located outdoors with very high gain antennas (*i.e.*, higher than 30 dBi) an average EIRP emission limit of 82 dBm and a peak EIRP limit of 85 dBm, in each case minus 2 dB for every dB that the antenna gain is below 51 dBi.<sup>524</sup> At that time, the Commission observed that two primary types of equipment serving different markets have emerged to share the 57-64 GHz band: 1) in-building wireless personal area networking (WPAN) devices designed to share uncompressed high-definition (HD) data signals between consumer entertainment devices, such as high-definition televisions (HDTV), cameras, and laptop computers, usually within the same room; and 2) outdoor short-range point-to-point systems intended to extend the reach of fiber optic networks by providing service to adjacent structures, provide broadband backhaul links between cellular networks base stations, or interconnect buildings in campus environments.<sup>525</sup>

309. At the request of the 60 GHz industry stakeholders that offer this second type of application,<sup>526</sup> the Commission adopted higher emission levels to provide longer range coverage for outdoor point-to-point links with very high-gain antennas resulting in very narrow beamwidths,<sup>527</sup> while

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<sup>521</sup> See *Above 40 GHz MO&O and Fourth FNPRM*, 12 FCC Rcd at 12214-12215 ¶¶ 6-11.

<sup>522</sup> Fixed field disturbance sensors must limit emissions to less than 10 dBm peak EIRP as well as the peak transmitter conducted output power to less than -10 dBm. 47 C.F.R. § 15.255(b)(2) & (b)(3). However, they are allowed to operate within the 61.0-61.5 GHz frequency band at the same emission levels as communications devices, as long as they limit their emissions outside of this 500 MHz band to less than 10 dBm average / 13 dBm peak EIRP in the rest of the 57-64 GHz band. This requirement was part of the spectrum etiquette developed by the Millimeter Wave Communications Working Group (MWCWG) at the behest of the Commission to facilitate co-existence of all 60 GHz devices in the 57-64 GHz band, and adopted into the rules in 1998. See Revision of Part 15 of the Commission's Rules Regarding Operation in the 57-64 GHz Band, *Third Report and Order*, ET Docket No. 94-124, 13 FCC Rcd 15074 (1998). The spectrum etiquette is available at <http://www.fcc.gov/oet/dockets/et94-124/etiquette.pdf>.

<sup>523</sup> 47 C.F.R. § 15.255(b)(1)(i).

<sup>524</sup> 47 C.F.R. § 15.255(b)(1)(ii).

<sup>525</sup> See Revision of Part 15 of the Commission's Rules Regarding Operation in the 57-64 GHz Band, ET Docket No. 07-113, *Report and Order*, 28 FCC Rcd at 12519 ¶ 5 (2013) ("*60 GHz Report and Order*").

<sup>526</sup> See Petition for Rule Making submitted by WCA, RM-11104.

<sup>527</sup> 47 C.F.R. § 15.255(b)(1)(ii). Higher-gain antennas have narrower beamwidths, which minimize the potential for harmful interference. Some of the products that fit into this category use antenna beamwidths as narrow as 1.4 degrees, requiring the use of special alignment tools to adjust the point-to-point link between transmitter and receiver. See *60 GHz Report and Order*, 28 FCC Rcd at 12527 ¶ 26.

maintaining the existing lower emission levels for any application indoors or outdoors.<sup>528</sup> In adopting the higher EIRP limits, the Commission determined that “[t]he high propagation losses in the 60 GHz band combined with the pencil beam of the high-gain antennas substantially mitigate the interference potential of these devices . . . [a]s the antenna gain increases, the beamwidth of the antenna becomes narrower, making it less likely that these devices will cause interference to nearby receivers unless they are located directly in the path of this pencil-thin antenna beam.”<sup>529</sup>

310. We believe that future 5G technologies, similar to existing 4G or LTE technologies, would take advantage of mobile data off-loading<sup>530</sup> to unlicensed operations at Wi-Fi hotspots<sup>531</sup>, either indoors or outdoors, as well as leveraging short backhaul links between pico cells.<sup>532</sup> Therefore, we believe the existing two types of emission limits that we propose to apply to the 64-71 GHz band will continue to benefit both the low-power networking communication links, including mobile use for data and voice communications, and the high-power high-antenna-gain fixed point-to-point backhaul links. We further note that although oxygen attenuation is most severe in the 57-64 GHz band which is approximately centered at 60 GHz,<sup>533</sup> its effect becomes much less pronounced in the adjacent 64-71 GHz band. Thus, equipment operating in the proposed 64-71 GHz band at the same emission levels would effectively be able to provide longer range and higher data throughput, as these levels are not as attenuated by the oxygen phenomenon.<sup>534</sup> We seek comment on these tentative conclusions.

311. *Spurious Emissions.* Section 15.255(c) restricts spurious emissions to a power density limit of 90 pW/cm<sup>2</sup> at a distance of 3 meters for frequencies between 40 and 200 GHz,<sup>535</sup> and to the general limit for intentional radiators in section 15.209 for frequencies below 40 GHz.<sup>536</sup> We propose to apply the same spurious emissions limits to transmitters operating in the proposed 64-71 GHz band. We seek comment on this proposal.

<sup>528</sup> Transmitters that do not incorporate very high gain antennas (*i.e.*, antenna gains less than 30 dBi) must limit emissions to 40 dBm EIRP and the peak power to 43 dBm EIRP. 47 C.F.R. § 15.255(b)(1)(i).

<sup>529</sup> *60 GHz Report and Order*, 28 FCC Rcd at 12527 ¶ 26. For example, some 60 GHz point-to-point products such as the Airlinx Communications GE60 series have an antenna beamwidth of 1.4 degrees with an antenna gain of 40 dBi, whereas the Airlinx Communications GE60X series has an antenna beamwidth of 0.6 degrees with an antenna gain of 46 dBi. *See* <http://www.airlinx.com/files/AIRLINX%20Bridgewave%2060GHz%20Data%20Sheet%200606.pdf>.

<sup>530</sup> Mobile data off-loading refers to the use of complementary network technologies, such as low-power unlicensed radio access nodes, for delivering data originally targeted for cellular networks.

<sup>531</sup> A hotspot is a physical location that offers Internet access over a wireless local area network (WLAN) through the use of a router connected to a link to an Internet service provider. Hotspots typically use Wi-Fi technology. Hotspots may be found in coffee shops and various other public establishments in many developed urban areas throughout the world.

<sup>532</sup> A pico cell is a wireless communication system typically covering a small physical area, whereas a macro cell is capable of covering a large physical area.

<sup>533</sup> Attenuation of radio waves caused by oxygen is a little more than 15 dB/km at 60 GHz, and about 3 dB/km at 70 GHz. *See* OET Bulletin 67, *Millimeter Wave Propagation: Spectrum Management Implications*, July 1997, available at [https://transition.fcc.gov/Bureaus/Engineering\\_Technology/Documents/bulletins/oet70/oet70a.pdf](https://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet70/oet70a.pdf).

<sup>534</sup> *Id.* *See also Attenuation by Atmospheric Gases*, International Telecommunications Union, *Reports of the CCIR*, 1990, Vol V, Report 719-3, at pg. 189.

<sup>535</sup> A power density of 90 pW/cm<sup>2</sup> is equivalent to a field strength of 18430 μV/m or 85.3 dBμV/m; and to an EIRP of -10 dBm. Power density (P<sub>D</sub>), EIRP and field strength (E) are readily converted through the following formulae: P<sub>D</sub> = E<sup>2</sup>/120(Pi) = EIRP / (4 Pi D<sup>2</sup>), where D is the separation distance in meters, provided measurements are performed in the far field.

<sup>536</sup> 47 C.F.R. § 15.255(c); 47 C.F.R. § 15.209(a). The limit for emissions above 960MHz is 500 μV/m (54 dBμV/m) as measured at 3 meters, or -41.3 dBm EIRP.

312. *Publicly-Accessible Coordination Channel.* Section 15.255(d) sets aside a publicly-accessible coordination channel in the 57.00-57.05 GHz band, in which only spurious emissions and emissions related to coordination techniques regarding interference management between diverse, non-interoperable, transmitters are permitted.<sup>537</sup> The rules further stipulate that the development of standards for this channel shall be performed pursuant to experimental authorizations issued under Part 5 of the Commission's rules.<sup>538</sup> This requirement was adopted in 1998 and modified in 2000 at the request of industry.<sup>539</sup> However, since 1998, there has been no report submitted to the FCC related to any specific experimental research with respect to this band.<sup>540</sup> We also observe that with recent technological advances and industry standardization, co-existence between 60 GHz devices is better resolved by voluntary standards than by a coordination channel requirement in the rules.<sup>541</sup> Because specifications on coordination techniques could reside in industry standards, we question the need to maintain a requirement that adds costs to equipment design and installation.<sup>542</sup> Removing this requirement would also provide an extra 50 MHz of spectrum for data transmission. We propose to remove this requirement from the rules and seek comment on this proposal, including its costs and benefits.

313. *Conducted Transmitter Output Power.* Section 15.255(e) limits the peak transmitter conducted output power of 57-64 GHz unlicensed devices to 500 mW (*i.e.*, 27 dBm) for transmitters with an emission bandwidth of at least 100 MHz, and is reduced for systems that employ narrower bandwidths.<sup>543</sup> We propose to apply this conducted transmitter output power requirement to transmitters operating in the proposed 64-71 GHz band. We seek comment on this proposal.

314. *Frequency Stability.* Section 15.255(f) requires that fundamental emissions be contained within the 57-64 GHz frequency band during all conditions of operation; and that equipment be able to operate over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage.<sup>544</sup> In adopting this requirement, the Commission noted that "... [m]illimeter wave devices generally are more susceptible to changes in operating frequency due to fluctuations in

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<sup>537</sup> 47 C.F.R. § 15.255(d).

<sup>538</sup> 47 C.F.R. § 5, *et seq.*

<sup>539</sup> See Revision of Part 15 of the Commission's Rules Regarding Operation in the 57-64 GHz Band, ET Docket No. 94-124, *Third Report and Order*, 13 FCC Rcd 15074, 15077-15078 ¶¶ 10-11 (1998); Amendment of Part 2 of the Commission's Rules to Allocate Additional Spectrum to the Inter-Satellite, Fixed, and Mobile Services and to Permit Unlicensed Devices to Use Certain Segments in the 50.2-50.4 GHz and 51.4-71.0 GHz Bands, ET Docket No. 99-261, *Report and Order*, 15 FCC Rcd 25264, 25280-25281 ¶ 39 (2000).

<sup>540</sup> Since 1998, the Commission has granted 116 experimental licenses which included the 57-57.05 GHz band; however, no research specific to the development of standards related to the coordination channel in Section 15.255(d) has been submitted to the FCC as a result of these experiments.

<sup>541</sup> See *e.g.*, IEEE 802.11ad-2012 Standard - *Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 3: Enhancements for Very High Throughput in the 60 GHz Band*; IEEE 802.15.3c-2009 Standard - *Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements. Part 15.3: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for High Rate Wireless Personal Area Networks (WPANs) Amendment 2: Millimeter-wave-based Alternative Physical Layer Extension*.

<sup>542</sup> In 2013, the Commission also removed a similar requirement, the Transmitter Identification, which was also adopted in 1998, for similar reasons. See *60 GHz Report and Order*, 28 FCC Rcd at 12533-12534 ¶¶ 41-43.

<sup>543</sup> See 47 C.F.R. § 15.255(e). The 500 mW limit is equivalent to 27 dBm, with  $P \text{ (dBm)} = 10 \log (P \text{ (mW)})$ .

<sup>544</sup> 47 C.F.R. § 15.255(f).

temperature or voltage than are transmitters operating at lower frequencies.”<sup>545</sup> We propose to apply the same requirements to transmitters operating in the proposed 64-71 GHz band. We seek comment on this proposal.

315. *Co-location of separately-authorized transmitters.* Section 15.255(h) allows group installation of transmitters that have been tested separately for compliance with the rules and received separate equipment authorizations, as long as no transmitter in the group is equipped with external phase-locking inputs that permit beam-forming arrays to be realized. This requirement seeks to prevent the possibility of producing a high-power coherent beam from discrete transmitters that have not been tested for compliance together, which could lead to non-compliance with the emission limits. This requirement does not preclude the use of advanced antenna technologies with beam-forming arrays in any transmitter, as long as its emissions in any array configuration comply with the limits on emissions and on RF exposure in the rules.<sup>546</sup> We propose to apply the same requirement to equipment operating in the proposed 64-71 GHz band. We seek comment on this proposal.

## 10. Sharing Analysis and Modeling

316. The Commission recognizes that having widely accepted propagation models for millimeter wave bands is one of the key steps towards 5G technology development and interservice sharing in mmW bands. While the propagation models of low frequency bands are well understood and practiced, mainly due to their long history, the wireless industry and academia are currently engaged in development of propagation models for millimeter wave bands.<sup>547</sup> The Satellite Industry Association (SIA) and Echostar have filed comments raising their own questions on what types of propagation models might be used for sharing analysis between satellite and terrestrial systems.<sup>548</sup> NYU also filed comments emphasizing the importance of propagation modeling for mmW band technology development.<sup>549</sup>

317. We seek comment on the various sharing analysis framework among fixed, mobile and satellite systems, as well as between active and passive services in the millimeter bands. Specifically, we request technical information on transmitter and receiver characteristics including peak and average transmit power and antenna performance, operational assumptions including antenna orientation and practical use case of transmitters and receivers, and appropriate propagation models for each sharing analysis that would assist in evaluating interference potential including aggregate effects as applicable.

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<sup>545</sup> See Amendment of Parts 2, 15, and 97 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications, ET Docket No. 94-124, *First Report & Order and Second Notice of Proposed Rulemaking*, 11 FCC Rcd 4481, 4507 ¶ 59 (1995).

<sup>546</sup> Guidance for compliance testing of millimeter-wave transmitters is found in C63.10-2013, *American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices*, Clause 9, available at <https://standards.ieee.org/findstds/standard/C63.10-2013.html>; and in a series of KDB Publications: KDB No. 662911 D01 *Emissions Testing of Transmitters with Multiple Outputs in the same Band*, and D02 *MIMO with Cross-polarized Antenna*, available at <https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?switch=P&id=49466>; KDB No. 200443, *Millimeter Wave Devices Measurement Procedures*, available at <https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=20677&switch=P>.

<sup>547</sup> In July 2015, the National Institute of Standards and Technology (NIST) initiated the 5G Millimeter Wave Channel Model Alliance with companies, academia, and government organizations to support the development more accurate, consistent, and predictive channel models. See <http://www.nist.gov/ctl/upload/5G-Millimeter-Wave-Channel-Model-AllianceV2.pdf>.

<sup>548</sup> See Letter from Tom Stroup, President, Satellite Industry Association to Marlene H. Dortch, Secretary, Federal Communications Commission (filed Sep. 23, 2015) at 2-4; Letter from Jennifer A. Manner, Vice President, Regulatory Affairs, EchoStar Satellite Operating Corporation to Marlene H. Dortch, Secretary, Federal Communications Commission (filed Sep. 15, 2015) at 2-4.

<sup>549</sup> Millimeter-Wave Channel Modeling and Heating Exposure Considerations, NYU Wireless (filed Sep. 28, 2015).

## 11. Equipment Authorization

318. There are some unique technical challenges specific to demonstrating compliance for the purpose of equipment authorization of millimeter-wave devices that may need to be addressed through guidance by the FCC Laboratory or future Commission proceedings. For example, as discussed above, it is expected that the millimeter-wave devices being contemplated are expected to be designed with an array of multiple antennas employing dynamic beamforming and no output port for which to measure the conducted power of the transmitter, which may make challenging the verification of transmitter power, equivalent isotropic radiated power (EIRP), and antenna gain.<sup>550</sup> Additionally, devices authorized for operation above 6 GHz have so far been intended for normal use at least 20 centimeters from the body of the user, introducing new challenges for measurement of RF exposure for such devices at close distances.<sup>551</sup> Throughout the next two sections, we seek comment on how we should address these technical challenges in future guidance to demonstrate compliance with the Commission's rules pertaining to equipment authorization. Specifically, we request information on relevant research as we address two topics: 1) measurement techniques to verify that devices meet limits on peak EIRP and out-of-band emissions (OOBE), and 2) demonstration of compliance with respect to the Commission's rules on RF exposure.

### a. Measurement Techniques

319. *EIRP Measurement.* Above we proposed a maximum device EIRP, without a limitation on device conducted power or antenna gain.<sup>552</sup> Present FCC Laboratory guidance addresses to a certain extent some of the technical procedures that could inform compliance demonstration with the proposed rules under consideration for millimeter-wave devices herein.<sup>553</sup> However, direct measurement of the fundamental EIRP of millimeter-wave devices including those that use dynamic beamforming antenna arrays across channel bandwidths of 100 MHz (or more) at millimeter-wave frequencies are more challenging than the present guidance for a number of reasons. For instance, when performing radiated emission measurements there may be significant losses depending on the test measurement setup, and attempts to recoup some of the added losses could introduce additional complexity, perhaps by requiring that measurements be performed in the radiating near-field of the device under testing. This presents practical problems of measurement repeatability and consistency. Additionally, the equivalent antenna gain of the device under testing depends on the frequencies being measured and in the case of beamforming arrangements, the direction of the beam being formed, which is especially true across wide channels such as those being contemplated for millimeter-wave devices. We seek information on fundamental aspects of measurements of radiated emissions at these frequencies. What are the ways to demonstrate compliance with procedures which are practical, repeatable and do not have large margins of errors. We further seek comment on whether and how present procedures can be adapted or modified to appropriately to address these specific technical challenges presented by millimeter-wave devices.

320. *Out-of-Band and Spurious Emissions Measurement.* Conventionally, out-of-band and spurious emissions are verified by direct measurement of conducted power at an output port, which

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<sup>550</sup> See ¶ 5, *supra*.

<sup>551</sup> In the proposed millimeter wave service rules, “mobile” refers to any device operating on the uplink spectrum, to include wireless modems, wireless user equipment, *etc.*, in contrast to the RF exposure rules, which further separate such devices between two additional categories based on exposure: “mobile” (which is defined as use in other than fixed locations and generally in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons) and “portable” (which is defined as use in such a way that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user).

<sup>552</sup> See Section IV.F.3.a, *supra*.

<sup>553</sup> See, e.g., KDB Publication 662911.

avoids the additional losses and uncertainties associated with field measurements.<sup>554</sup> However, millimeter-wave devices being contemplated are likely not to have an output port, primarily due to the manner in which the antennas in the array will be fed. At the present time the FCC Laboratory guidance does offer a procedure to measure the out-of-band and spurious emissions from devices with multiple antennas.<sup>555</sup> The measurement challenges introduced in the previous paragraph regarding significant losses<sup>556</sup> that could be introduced depending on the test measurement setup are accentuated in the case of out-of-band and spurious measurements due to the low levels relative to the fundamental emissions. We seek comment on what other measurement procedures may be used and whether we would need to provide any additional guidance to determine compliance with the out-of-band and spurious emission limits for millimeter-wave devices considering the technical challenges. Additionally, out-of-band emissions limits are presently measured using a 100 kHz bandwidth at operating frequencies below 1 GHz, and are measured using a 1 MHz bandwidth at operating frequencies above 1 GHz. We seek comment on whether we should further consider widening the measurement bandwidth, say to 10 MHz above 10 GHz, and what might be the practical implications in doing so. For example, a wider measurement bandwidth would include more thermal noise, which could make measurement more difficult because of the increased noise to a point higher than the emissions limits. We seek comment on this proposal. Finally, spurious emissions for devices operating above 10 GHz are required by the Commission's rules to be measured up to the fifth harmonic of the highest fundamental frequency, below a certain cutoff frequency.<sup>557</sup> We seek comment on whether these cutoff frequencies should be modified.

#### **b. RF Exposure Compliance**

321. Radiofrequency (RF) devices must comply with the Commission's RF exposure limits.<sup>558</sup> The Commission has an open proceeding in which it is examining its RF exposure rules and policies, which could potentially influence how such devices are authorized in the future.<sup>559</sup> We propose to similarly require compliance with the radiofrequency radiation exposure specifications in sections 1.1307(b), 2.1091 and 2.1093 of the rules to equipment operating in the Upper Microwave Flexible Use Service. We seek comment on this proposal; however, any issues raised involving the present exposure limits themselves as they exist today will be dealt with in the context of that separate proceeding.

322. Presently, the Commission's rules include two types of guidelines limiting exposure to RF energy: 1) specific absorption rate (SAR),<sup>560</sup> and 2) maximum permissible exposure (MPE).<sup>561</sup> There is no SAR limit for operations above 6 GHz, rather the MPE limit on total power flux density must be

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<sup>554</sup> For licensed devices, measurement procedures are described in 47 C.F.R. §§ 2.1051 and 2.1053. For unlicensed devices, measurement procedures are described in *See* 47 C.F.R. § 15.31.

<sup>555</sup> *See* KDB Publication 662911 D01 at 4.

<sup>556</sup> The challenges in making out-of-band and spurious emissions from millimeter wave devices are result the sensitivity of the measurement instrumentation resulting from the harmonic mixer conversion losses, small effective aperture of the measurement antennas at millimeter-wave frequencies and the system noise levels of the measurement receiver (*e.g.*, spectrum analyzer).

<sup>557</sup> *See* 47 C.F.R. § 2.1057. The cutoff for equipment operating from 10 GHz to 30 GHz is 100 GHz; the cutoff for equipment operating 30 GHz and above is 200 GHz.

<sup>558</sup> *See* 47 C.F.R. § 1.1310. *See also* 47 C.F.R. §§ 1.1307(b) (for fixed), 2.1091 (for mobile), and 2.1093 (for portable).

<sup>559</sup> *See* Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies; Proposed Changes in the Commission's Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields, ET Docket Nos. 13-84, 03-137, *First Report and Order (RF Order)* and *Further Notice of Proposed Rule Making (RF Further Notice)* and *Notice of Inquiry (RF Inquiry)*, 28 FCC Rcd 3498 (2013).

<sup>560</sup> *See* 47 C.F.R. § 1.1310(a)-(d).

<sup>561</sup> *See* 47 C.F.R. § 1.1310(e).

used to determine compliance at frequencies from 6 through 100 GHz.<sup>562</sup> Compliance with these rules for devices is demonstrated through the equipment authorization process, and will be subject to subsequent specific guidance on RF exposure compliance procedures.<sup>563</sup> Nevertheless, determining compliance with the RF exposure limit for portable devices (intended for use within 20 centimeters of the body of a user) operating above 6 GHz does present some unique technical challenges not addressed in our guidance documents and warrant some additional discussion. Recognizing the specific guidance on evaluation to be issued by the FCC Laboratory which will address how to demonstrate compliance with our exposure limits, and given the additional considerations in the Commission's pending proceeding on RF exposure rules and policies, we seek comment on how to address these technical challenges.

323. Conventionally, consumer portable devices operating at frequencies below 6 GHz intended to be held against the head during normal use are tested for SAR with the device placed directly against a head-shaped tissue-equivalent phantom defined by SAR measurement standards, called the specific anthropomorphic mannequin (SAM).<sup>564</sup> SAR is evaluated under specific exposure conditions within tissue-equivalent media. However, the more tractable MPE measurements are performed in free-space without a SAM present. MPE evaluations in free-space do not account for the specific exposure conditions in the body tissues; however, the MPE limits without spatial averaging have a built-in conservativeness that assumes whole-body exposure and ensures compliance with SAR limits below 6 GHz. We acknowledged in our proposals in the *RF Further Notice* that the five centimeter minimum distance for measurement and calculation of MPE in free-space specified in our rules appears to be inappropriate at frequencies above 6 GHz,<sup>565</sup> especially in the context of portable devices that may normally be operated closer than five centimeters from the head or body.<sup>566</sup> However, we also acknowledged in those proposals in the Commission's *RF Further Notice* that there could be some minimum distance at which device coupling with measurement probes could reduce measurement accuracy, even with today's advanced and more compact measurement equipment.<sup>567</sup> However, with

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<sup>562</sup> See 47 C.F.R. § 1.1310(e), Table 1. The MPE limit for general population/uncontrolled exposure above 6 GHz is 1 mW/cm<sup>2</sup>. Relaxed limits for the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, are not defined for MPE, thus the 1 mW/cm<sup>2</sup> limit applies to all parts of the body. Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled MPE limits. However, for portable devices intended for use by consumers "source-based" time averaging applies as described in 47 C.F.R. § 2.1093(d)(5). The MPE limit for occupational/controlled exposure above 6 GHz is 5 mW/cm<sup>2</sup>, averaged over a time period not to exceed 6 minutes.

<sup>563</sup> Preliminary interim test guidance on RF exposure compliance for evaluating 60 GHz transmitters was discussed in the April 2015 TCB workshop and is available at <https://transition.fcc.gov/bureaus/oet/ea/presentations/files/apr15/41-April-2015-RF-Exposure-TCB-Slides-KC.pdf>. This interim guidance requires equipment grantees and test labs to coordinate with the FCC Laboratory on applicable measurement or computation methods. As the Laboratory learns more about this emerging technology, the interim guidance will be updated through subsequent TCB workshops. At a point when the test procedures are matured and stable, the Laboratory will consider formal guidance in the form of a KDB publication.

<sup>564</sup> The standard procedure for measurement evaluation involves a specific anthropomorphic mannequin (SAM) in accord with IEEE Std 1528-2013 and IEC 62209-1 (2005). The SAM is based on a conservative model of the human head, consisting of a low-loss dielectric shell filled with tissue-equivalent liquid of uniform dielectric properties. A portable device is positioned against the SAM phantom in defined use conditions to perform SAR measurements consistent with the dielectric properties of the tissue-equivalent liquid required at the test frequencies.

<sup>565</sup> See *RF Further Notice*, 28 FCC Rcd at 3556 ¶ 172.

<sup>566</sup> 47 C.F.R. § 2.1093(d).

<sup>567</sup> One recent 60 GHz measurement method involves extrapolation of near-field results from far-field measurements. See *Application of the Planar-Scanning Technique to the Near Field Dosimetry of Millimeter-Wave Radiators*, Bioelectromagnetics 36 at 108–117 (February 2015).

computational techniques there may be no practical limitation on minimum distance.<sup>568</sup> We seek comment on what major factors, considering both measurement and computational techniques, we should take into account when developing guidance to evaluate consumer portable devices operating at frequencies above 6 GHz intended to be held against the head or close to the body during normal use.<sup>569</sup> We encourage comments addressing whether the technical challenges described above regarding probe-device coupling in the near-field are surmountable when measuring MPE, and whether suitable techniques can be established to validate the computational model used in simulations of near-field power density.<sup>570</sup>

324. As noted above,<sup>571</sup> consistent with other existing advanced wireless service rules, we are proposing a 20 watts (43 dBm) peak EIRP for mobile devices.<sup>572</sup> However, the major distinctions between millimeter-wave devices being contemplated and existing wireless devices are the default use of an array of multiple antennas with no output port at which to measure the conducted power of the transmitter.<sup>573</sup> Also mentioned in our proposals in the *RF Further Notice* was the rationale for a maximum averaging area of one square centimeter for MPE above 6 GHz to be consistent with one gram averaging of SAR.<sup>574</sup> We note that the antenna array dimensions being contemplated can be significantly larger than a single square centimeter, and every antenna in an array is being fed equal power, effectively

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<sup>568</sup> See *RF Further Notice*, 28 FCC Rcd at 3556 ¶ 171. We noted that currently available probes, which have diameters as small as approximately 5 millimeters, could be limited to a “three-probe diameter” minimum measurement distance of 1.5 centimeters. When computational modeling millimeter-wave devices, voxel/mesh sizes would ideally be much smaller than a fraction of a millimeter for modeling specific details of small antenna array elements and structures.

<sup>569</sup> For a discussion on separation distance during SAR compliance testing of body-worn configurations, see *RF Inquiry*, 28 FCC Rcd at 3587-3589 ¶¶ 248-252.

<sup>570</sup> We note that numerical simulation presently requires code validation against measured results according to draft IEC 62704-1 (or equivalent) procedures that apply from 30 MHz to 6 GHz and requires additional consideration and adaptation before it can be applied at frequencies above 6 GHz. A KDB inquiry is highly recommended to avoid invalid test configurations and unacceptable results. See interim RF exposure compliance procedures, including specific guidance for evaluating 60 GHz transmitters, *supra* n.563.

<sup>571</sup> See Section IV.F.3.b, *supra*.

<sup>572</sup> In the proposed millimeter wave service rules, “mobile” refers to any device operating on the uplink spectrum, to include wireless modems, wireless user equipment, *etc.*, in contrast to the RF exposure rules, which further separate such devices between two additional categories based on exposure: “mobile” (which is defined as use in other than fixed locations and generally in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons) and “portable” (which is defined as use in such a way that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user).

<sup>573</sup> See ¶ 320, *supra*.

<sup>574</sup> See *RF Further Notice*, 28 FCC Rcd at 3539 ¶ 125. Applying this SAR equivalency rationale to the MPE limit for general population/uncontrolled exposure above 6 GHz, the limit would more specifically be 10 W/m<sup>2</sup>, averaged over any 1 cm<sup>2</sup> (defined in the shape of a 1 cm-by-1 cm square). Note the conversion from mW/cm<sup>2</sup> to W/m<sup>2</sup> for international system (SI) units: (10,000 cm<sup>2</sup>) / (1 m<sup>2</sup>) \* (1 W) / (1,000 mW) = 10. However, see also *RF Further Notice* at para. 126, 28 FCC Rcd 3540 (2013), where “we seek comment on whether the blanket exemption as proposed may not be adequate to prevent exposure over our limits, for example, in a situation involving multiple high-gain millimeter-wave radiators.” No comments were received in response to this specific solicitation of comments. See also *RF Inquiry*, 28 FCC Rcd at 3576-3578 ¶¶ 221-224. In particular, see ¶ 221: “As portable devices are developed for operation at higher frequencies, lack of clear definitions of spatial peak and spatially averaged power density in our limits may become more significant. We invite comment on whether we should change or clarify spatial averaging requirements and spatial maximum power density limits, at least at higher frequencies, either in our rules limiting human exposure to RF energy or in our non-mandatory materials.”

spreading the power across the entire aperture of the device's antenna array.<sup>575</sup> In this regard, peak EIRP in the far-field is conceptually considered to be inversely related to the maximum power flux density of the antenna array in the near-field, and ultimately the maximum conducted power that could be used by the device while still complying with the Commission's RF exposure limits might not be related to peak EIRP, however we seek comment on this concept.<sup>576</sup> Recognizing also that portable devices are likely to operate at conducted power levels much lower than the proposed maximum peak EIRP,<sup>577</sup> due to antenna array gain and to effectively manage device power consumption among other reasons, we also seek comment on whether to maintain our continued approach to allow portable devices to be authorized up to the maximum EIRP permitted by the rules, as long as our RF exposure limits are met, and if not, what other alternative approaches we should consider.<sup>578</sup> Related to equipment authorization procedures, we specifically seek comment on whether an averaging area of one square centimeter would appropriately reflect the intent of the rationale behind our present exposure limits in the interim,<sup>579</sup> until the Commission considers the issues brought forth in its *RF Inquiry*.<sup>580</sup> Moreover, similar to the rationale that permits consideration of lateral separation between antennas measured for peak SAR in the context of reducing test requirements for some types of equipment operating at frequencies below 6 GHz,<sup>581</sup> and given the anticipated dimensions of antenna arrays for these devices, we seek comment on whether any one square centimeter averaging area across the dimensions of the array can be assessed independently while still adhering to the intent of these guidelines.

## V. PROCEDURAL MATTERS

### A. *Ex Parte* Rules – Permit-But-Disclose

325. Pursuant to section 1.1200(a) of the Commission's rules,<sup>582</sup> this *NPRM* shall be treated as a "permit-but-disclose" proceeding in accordance with the Commission's *ex parte* rules.<sup>583</sup> Persons making *ex parte* presentations must file a copy of any written presentation or a memorandum summarizing any oral presentation within two business days after the presentation (unless a different

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<sup>575</sup> See *Millimeter-Wave Beamforming as an Enabling Technology for 5G Cellular Communications: Theoretical Feasibility and Prototype Results*, Wonil Roh et al, IEEE Communications Magazine, February 2014.

<sup>576</sup> The expectation is that measurements are likely to be within the radiating near-field of a portable device, where the peak antenna gain is not fully realized, thus the exposure from individual antenna elements of an antenna array may contribute more significantly to localized exposure (the maximum power flux density averaged over any 1 cm square) than from the contribution of all elements of the array. Fundamentally, the peak EIRP in the far-field is inversely proportional to the power flux density in the near-field for aperture antennas, due to the proportional relationship between antenna gain and effective area, such that a higher antenna gain would require power to be spread over a larger area, resulting in a smaller power flux density at the surface of the antenna given a constant power supplied to the array.

<sup>577</sup> As an analogy, 3GPP technical specifications limit portable user equipment to a maximum of 23 dBm (200 milliwatts) conducted power, despite FCC rules permitting up to 3 watts under Part 27 of the rules for certain devices such as those intended for Public Safety operations; for example (3GPP) high power UE. See 47 C.F.R. § 27.50. See also 3GPP TS 36.101 V12.3.0 (3GPP RF UE Standard) at pp. 39-62 (Section 6.2), available at [http://www.3gpp.org/ftp/Specs/archive/36\\_series/36.101/36101-c30.zip](http://www.3gpp.org/ftp/Specs/archive/36_series/36.101/36101-c30.zip).

<sup>578</sup> See, e.g., 47 C.F.R. § 27.52.

<sup>579</sup> However, see *RF Further Notice*, 28 FCC Rcd at 3539-3540 ¶ 126.

<sup>580</sup> See generally *RF Inquiry*, 28 FCC Rcd at 3570 ¶ 205.

<sup>581</sup> See KDB Publication No. 447498, *Mobile and Portable Device, RF Exposure, Equipment Authorization Procedures*, 1.1307, 2.1091, 2.1093, available at: <https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=20676&switch=P>.

<sup>582</sup> 47 C.F.R. § 1.1200(a).

<sup>583</sup> 47 C.F.R. §§ 1.1200 *et seq.*

deadline applicable to the Sunshine period applies). Persons making oral *ex parte* presentations are reminded that memoranda summarizing the presentation must (1) list all persons attending or otherwise participating in the meeting at which the *ex parte* presentation was made, and (2) summarize all data presented and arguments made during the presentation. If the presentation consisted in whole or in part of the presentation of data or arguments already reflected in the presenter's written comments, memoranda or other filings in the proceeding, the presenter may provide citations to such data or arguments in his or her prior comments, memoranda, or other filings (specifying the relevant page and/or paragraph numbers where such data or arguments can be found) in lieu of summarizing them in the memorandum. Documents shown or given to Commission staff during *ex parte* meetings are deemed to be written *ex parte* presentations and must be filed consistent with rule 1.1206(b). In proceedings governed by rule 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations and memoranda summarizing oral *ex parte* presentations, and all attachments thereto, must be filed through the electronic comment filing system available for that proceeding, and must be filed in their native format (e.g., .doc, .xml, .ppt, searchable .pdf). Participants in this proceeding should familiarize themselves with the Commission's *ex parte* rules.

### **B. Comment Period and Procedures**

326. Pursuant to sections 1.415 and 1.419 of the Commission's rules, 47 CFR §§ 1.415, 1.419, interested parties may file comments and reply comments on or before the dates indicated on the first page of this document. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS). *See Electronic Filing of Documents in Rulemaking Proceedings*, 63 FR 24121 (1998).

- Electronic Filers: Comments may be filed electronically using the Internet by accessing the ECFS: <http://fjallfoss.fcc.gov/ecfs2/>.
- Paper Filers: Parties who choose to file by paper must file an original and one copy of each filing. If more than one docket or rulemaking number appears in the caption of this proceeding, filers must submit two additional copies for each additional docket or rulemaking number.

Filings can be sent by hand or messenger delivery, by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail. All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.

- All hand-delivered or messenger-delivered paper filings for the Commission's Secretary must be delivered to FCC Headquarters at 445 12<sup>th</sup> St., SW, Room TW-A325, Washington, DC 20554. The filing hours are 8:00 a.m. to 7:00 p.m. All hand deliveries must be held together with rubber bands or fasteners. Any envelopes and boxes must be disposed of before entering the building.
- Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9300 East Hampton Drive, Capitol Heights, MD 20743.
- U.S. Postal Service first-class, Express, and Priority mail must be addressed to 445 12<sup>th</sup> Street, SW, Washington DC 20554.

327. People with Disabilities: To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an e-mail to [fcc504@fcc.gov](mailto:fcc504@fcc.gov) or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (tty).

### C. Initial Regulatory Flexibility Analysis

328. As required by the Regulatory Flexibility Act of 1980 (RFA),<sup>584</sup> the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on small entities of the policies and rules proposed in the *Notice of Proposed Rulemaking*. The analysis is found in Appendix B. We request written public comment on the analysis. Comments must be filed in accordance with the same deadlines as comments filed in response to the *NRPM* and must have a separate and distinct heading designating them as responses to the IRFA. The Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, will send a copy of this *NPRM*, including the IRFA, to the Chief Counsel for Advocacy of the Small Business Administration.

### D. Paperwork Reduction Analysis

329. This document contains proposed new information collection requirements. The Commission, as part of its continuing effort to reduce paperwork burdens, invites the general public and the Office of Management and Budget (OMB) to comment on the information collection requirements contained in this document, as required by the Paperwork Reduction Act of 1995, Public Law 104-13. In addition, pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 44 U.S.C. 3506(c)(4), we seek specific comment on how we might further reduce the information collection burden for small business concerns with fewer than 25 employees.

### E. Further Information

330. For further information, contact John Schauble of the Wireless Telecommunications Bureau, Broadband Division, at 202-418-0797 or [John.Schauble@fcc.gov](mailto:John.Schauble@fcc.gov), Michael Ha of the Office of Engineering and Technology, Policy and Rules Division, at 202-418-2099 or [Michael.Ha@fcc.gov](mailto:Michael.Ha@fcc.gov), or Howard Griboff of the International Bureau, Policy Division, at 202-418-0657 or [Howard.Griboff@fcc.gov](mailto:Howard.Griboff@fcc.gov).

## VI. ORDERING CLAUSES

331. Accordingly, IT IS ORDERED, pursuant to Sections 1, 2, 3, 4, 5, 7, 10, 201, 225, 227, 301, 302, 302a, 303, 304, 307, 309, 310, 316, 319, 332, and 336 of the Communications Act of 1934, 47 U.S.C. §§ 151, 152, 153, 154, 155, 157, 160, 201, 225, 227, 301, 302, 302a, 303, 304, 307, 309, 310, 316, 319, 332, 336, Section 706 of the Telecommunications Act of 1996, as amended, 47 U.S.C. § 1302, and Section 1.411 of the Commission's Rules, 47 C.F.R. § 1.411, that this *Notice of Proposed Rulemaking* is hereby ADOPTED.

332. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this *Notice of Proposed Rulemaking*, including the Initial Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch  
Secretary

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<sup>584</sup> See 5 U.S.C. § 603.

**APPENDIX A**

**Proposed Rules**

For the reasons discussed in the preamble, the Federal Communications Commission hereby proposes to amend 47 CFR parts 1, 25, and 101 and add a new part 30 as follows:

**PART 1 – PRACTICE AND PROCEDURE**

1. The authority citation for Part 1 continues to read as follows:

Authority: 15 U.S.C. 79, *et seq.*; 47 U.S.C. 151, 154(i), 154(j), 155, 157, 160, 201, 225, 227, 303, 309, 332, 1403, 1404, 1451, 1452, and 1455.

2. Amend § 1.907 by revising the definitions for “Wireless Radio Services” and “Wireless Telecommunications Services” to read as follows:

\* \* \* \* \*

*Wireless Radio Services.* All radio services authorized in parts 13, 20, 22, 24, 26, 27, 30, 74, 80, 87, 90, 95, 96, 97 and 101 of this chapter, whether commercial or private in nature.

*Wireless Telecommunications Services.* Wireless Radio Services, whether fixed or mobile, that meet the definition of “telecommunications service” as defined by 47 U.S.C. 153, as amended, and are therefore subject to regulation on a common carrier basis. Wireless Telecommunications Services include all radio services authorized by parts 20, 22, 24, 26, 27, and 30 of this chapter. In addition, Wireless Telecommunications Services include Public Coast Stations authorized by part 80 of this chapter, Commercial Mobile Radio Services authorized by part 90 of this chapter, common carrier fixed microwave services, Local Television Transmission Service (LTTS), Local Multipoint Distribution Service (LMDS), and Digital Electronic Message Service (DEMS), authorized by part 101 of this chapter, and Citizens Broadband Radio Services authorized by part 96 of this chapter.

\* \* \* \* \*

3. Amend § 1.1307 by revising Table 1 in paragraph (b)(1) and paragraph (2)(i) to read as follows:

(b) \* \* \* \* \*

(1) \* \* \*

Table 1—Transmitters, Facilities and Operations Subject to Routine Environmental Evaluation

Service (title 47 CFR rule part)	Evaluation required if:
* * * * *	* * * * *
Upper Microwave Flexible Use Service (part 30)	Non-building-mounted antennas: height above ground level to lowest point of antenna <10 m and power >1640 W EIRP.
	Building-mounted antennas: Total power of all channels >1000 W ERP (1640 W EIRP).
* * * * *	* * * * *

(2)(i) Mobile and portable transmitting devices that operate in the Commercial Mobile Radio Services pursuant to part 20 of this chapter; the Cellular Radiotelephone Service pursuant to part 22 of this chapter;

the Personal Communications Services (PCS) pursuant to part 24 of this chapter; the Satellite Communications Services pursuant to part 25 of this chapter; the Miscellaneous Wireless Communications Services pursuant to part 27 of this chapter; the Upper Microwave Flexible Use Service pursuant to part 30 of this chapter; the Maritime Services (ship earth stations only) pursuant to part 80 of this chapter; the Specialized Mobile Radio Service, the 4.9 GHz Band Service, or the 3650 MHz Wireless Broadband Service pursuant to part 90 of this chapter; the Wireless Medical Telemetry Service (WMTS), or the Medical Device Radiocommunication Service (MedRadio) pursuant to part 95 of this chapter; or the Citizens Broadband Radio Service pursuant to part 96 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use, as specified in §§2.1091 and 2.1093 of this chapter.

4. Amend § 1.9001 by revising paragraph (a) to read as follows:

(a) The purpose of part 1, subpart X is to implement policies and rules pertaining to spectrum leasing arrangements between licensees in the services identified in this subpart and spectrum lessees. This subpart also implements policies for private commons arrangements. These policies and rules also implicate other Commission rule parts, including parts 1, 2, 20, 22, 24, 25, 27, 30, 80, 90, 95, and 101 of title 47, chapter I of the Code of Federal Regulations.

\* \* \* \* \*

5. Amend § 1.9005 by revising paragraphs (hh) through (kk) and adding paragraph (ll) to read as follows:

\* \* \* \* \*

(hh) The Multipoint Video Distribution and Data Service (part 101 of this chapter);  
 (ii) The 700 MHz Guard Bands Service (part 27 of this chapter);  
 (jj) The ATC of a Mobile Satellite Service (part 25 of this chapter);  
 (kk) The 600 MHz band (part 27 of this chapter); and  
 (ll) The Upper Microwave Flexible Use Service (part 30 of this chapter).

\* \* \* \* \*

## **Part 2 – Frequency Allocations and Radio Treaty Matters; General Rules and Regulations**

6. The authority citation for Part 2 continues to read as follows:

AUTHORITY: 47 U.S.C. 154, 302a, 303, and 336, unless otherwise noted.

7. Section 2.1091 is proposed to be amended to read as follows:

### **§ 2.1091 Radiofrequency radiation exposure evaluation: mobile devices**

\* \* \* \* \*

(c)(1) Mobile devices that operate in the Commercial Mobile Radio Services pursuant to part 20 of this chapter; the Cellular Radiotelephone Service pursuant to part 22 of this chapter; the Personal Communications Services pursuant to part 24 of this chapter; the Satellite Communications Services pursuant to part 25 of this chapter; the Miscellaneous Wireless Communications Services pursuant to part 27 of this chapter; the Upper Microwave Flexible Use Service pursuant to part 30 of this chapter; the Maritime Services (ship earth station devices only) pursuant to part 80 of this chapter; the Specialized Mobile Radio Service, and the 3650 MHz Wireless Broadband Service pursuant to part 90 of this chapter; and the Citizens Broadband Radio Service pursuant to part 96 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if:

\* \* \* \* \*

8. Section 2.1093 is proposed to be amended to read as follows:

### **§ 2.1093 Radiofrequency radiation exposure evaluation: portable devices**

\* \* \* \* \*

(c)(1) Portable devices that operate in the Cellular Radiotelephone Service pursuant to part 22 of this chapter; the Personal Communications Service (PCS) pursuant to part 24 of this chapter; the Satellite Communications Services pursuant to part 25 of this chapter; the Miscellaneous Wireless Communications Services pursuant to part 27 of this chapter; the Upper Microwave Flexible Use Service pursuant to part 30 of this chapter; the Maritime Services (ship earth station devices only) pursuant to part 80 of this chapter; the Specialized Mobile Radio Service, the 4.9 GHz Band Service, and the 3650 MHz Wireless Broadband Service pursuant to part 90 of this chapter; the Wireless Medical Telemetry Service (WMTS) and the Medical Device Radiocommunication Service (MedRadio), pursuant to subparts H and I of part 95 of this chapter, respectively, unlicensed personal communication service, unlicensed NII devices and millimeter wave devices authorized under §§ 15.253(f), 15.255(g), 15.257(g), 15.319(i), and 15.407(f) of this chapter; and the Citizens Broadband Radio Service pursuant to part 96 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use.

\* \* \* \* \*

## PART 15 – RADIO FREQUENCY DEVICES

9. The authority citation for Part 15 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, 304, 307, 336, 544a, and 549.

10. Section 15.255 is proposed to be amended by revising the section title, paragraphs (b)(1), (b)(2), (b)(4), and (c)(1), removing paragraph (d), revising paragraph (e)(2), re-designating paragraphs (e) through (h) as paragraphs (d) through (g), and adding paragraph (h) to read as follows:

### **§ 15.255 Operation within the band 57-71 GHz.**

\* \* \* \* \*

(b) Within the 57-71 GHz band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):

(1) Products other than fixed field disturbance sensors shall comply with one of the following emission limits, as measured during the transmit interval:

(i) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm; OR

(ii) For fixed point-to-point transmitters located outdoors, the average power of any emission shall not exceed 82 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.

(A) The provisions in this paragraph for reducing transmit power based on antenna gain shall not require that the power levels be reduced below the limits specified in paragraph (b)(1)(i) of this section.

(B) The provisions of §15.204(c)(2) and (c)(4) of this part that permit the use of different antennas of the same type and of equal or less directional gain do not apply to intentional radiator systems operating under this provision. In lieu thereof, intentional radiator systems shall be certified using the specific antenna(s) with which the system will be marketed and operated. Compliance testing shall be performed using the highest gain and the lowest gain antennas for which certification is sought and with

the intentional radiator operated at its maximum available output power level. The responsible party, as defined in §2.909 of this chapter, shall supply a list of acceptable antennas with the application for certification.

(2) For fixed field disturbance sensors that occupy 500 MHz or less of bandwidth and that are contained wholly within the frequency band 61.0-61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61.0-61.5 GHz band, measured during the transmit interval, but still within the 57-71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.

(3) \* \* \*

(4) The peak power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-71 GHz band and has a video bandwidth of at least 10 MHz. The average emission levels shall be measured over the actual time period during which transmission occurs.

(c) Limits on spurious emissions:

(1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.

\* \* \* \* \*

(d) Except as specified paragraph (d)(1) of this section, the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (b) of this section.

(1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

(2) Peak transmitter conducted output power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-71 GHz band and that has a video bandwidth of at least 10 MHz.

(3) For purposes of demonstrating compliance with this paragraph, corrections to the transmitter conducted output power may be made due to the antenna and circuit loss.

(e) *Frequency stability.* Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

(f) Regardless of the power density levels permitted under this section, devices operating under the provisions of this section are subject to the radiofrequency radiation exposure requirements specified in §§1.1307(b), 2.1091 and 2.1093 of this chapter, as appropriate. Applications for equipment authorization

of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

(g) Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

(h) Measurement procedures that have been found to be acceptable to the Commission in accordance with §2.947 of this chapter may be used to demonstrate compliance.

## **PART 25 – SATELLITE COMMUNICATIONS**

11. The authority citation for Part 25 continues to read as follows:

Authority: Interprets or applies sections 4, 301, 302, 303, 307, 309, 319, 332, 705, and 721 of the Communications Act, as amended, 47 U.S.C. 154, 301, 302, 303, 307, 309, 319, 332, 605, and 721, unless otherwise noted.

12. Amend § 25.202 by amending footnote 2 to the table in paragraph (a)(1) to read as follows:

### **§ 25.202 Frequencies, frequency tolerance, and emission limits.**

(a)  
(1) \* \* \*

<sup>2</sup> FSS is co-primary if the FSS licensee also holds the Upper Microwave Flexible Use license for the area where the earth station is located. Otherwise, FSS is secondary to the Upper Microwave Flexible Use Service.

13. Part 30 of Title 47 of the Code of Federal Regulations is proposed to be added as follows:

## **PART 30 – UPPER MICROWAVE FLEXIBLE USE SERVICE**

### **Subpart A – General**

Sec.

- 30.1 Creation of Upper Microwave Flexible Use Service.
- 30.2 Definitions.
- 30.3 Eligibility.
- 30.4 Frequencies.
- 30.5 Service Areas.
- 30.6 Permissible Communications.

### **Subpart B – Applications and Licenses**

- 30.101 Initial Authorization.
- 30.102 Authorization of Operation of Local Area Networks in 37-38.6 GHz Band.
- 30.103 Transition of Existing Local Multipoint Distribution Service and 39 GHz Licenses.
- 30.104 License Term.
- 30.105 Construction Requirements.
- 30.106 Geographic Partitioning and Spectrum Disaggregation.

30.107 Discontinuance of Service.

**Subpart C – Technical Standards**

30.201 Equipment Authorization.

30.202 Power Limits.

30.203 Emission Limits.

30.204 Field Strength Limits.

30.205 Information Sharing Requirements.

30.206 Federal Coordination Requirements.

30.207 International Coordination.

30.208 RF Safety.

30.209 Interoperability.

**Subpart D – Competitive Bidding Procedures**

30.301 Upper Microwave Flexible Use Service Subject to Competitive Bidding.

30.302 Designated Entities and Bidding Credits.

AUTHORITY: 47 U.S.C. §§ 151, 152, 153, 154, 301, 303, 304, 307, 309, 310, 316, 332, 1302

**§ 30.1 Creation of Upper Microwave Flexible Use Service.**

As of [insert effective date of rule], Local Multipoint Distribution Service licenses for the 27.5-28.35 GHz band, and licenses issued in the 38.6-40 GHz band under the rules in Part 101 of this chapter shall be reassigned to the Upper Microwave Flexible Use Service. Local Multipoint Distribution Service licenses in bands other than 27.5-28.35 GHz shall remain in that service and shall be governed by the Part 101 rules applicable to that service.

**§ 30.2 Definitions.**

*Authorized bandwidth.* The maximum width of the band of frequencies permitted to be used by a station. This is normally considered to be the necessary or occupied bandwidth, whichever is greater. (See §2.202 of this chapter).

*Base station.* A station at a fixed location used as part of a mobile service.

*Effective Radiated Power (ERP) (in a given direction).* The product of the power supplied to the antenna and its gain relative to a half-wave dipole in a given direction.

*Equivalent Isotropically Radiated Power (EIRP).* The product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna.

*Fixed service.* A radio communication service between specified fixed points.

*Fixed station.* A station in the fixed service.

*Local Area Operations.* Operations confined to physical facility boundaries, such as a factory.

*Mobile service.* A radio communication service between mobile and land stations, or between mobile stations.

*Mobile station.* A station in the mobile service intended to be used while in motion or during halts at unspecified points.

*Point-to-point station.* A station that transmits a highly directional signal from a fixed transmitter location to a fixed receive location.

*Universal Licensing System.* The Universal Licensing System (ULS) is the consolidated database, application filing system, and processing system for all Wireless Radio Services. ULS supports electronic filing of all applications and related documents by applicants and licensees in the Wireless Radio Services, and provides public access to licensing information.

### **§ 30.3 Eligibility.**

Any entity who meets the technical, financial, character, and citizenship qualifications that the Commission may require in accordance with such Act, other than those precluded by section 310 of the Communications Act of 1934, as amended, 47 U.S.C. 310, is eligible to hold a license under this part.

### **§ 30.4 Frequencies.**

The following frequencies are available for assignment in the Upper Microwave Flexible Use Service:

- (a) 27.5 GHz – 28.35 GHz band;
- (b) 38.6-40 GHz band:

<b>Channel Group A</b>		<b>Channel Group B</b>	
<b>Channel No.</b>	<b>Frequency band limits (MHz)</b>	<b>Channel No.</b>	<b>Frequency band limits (MHz)</b>
1-A	38,600-38,650	1-B	39,300-39,350
2-A	38,650-38,700	2-B	39,350-39,400
3-A	38,700-38,750	3-B	39,400-39,450
4-A	38,750-38,800	4-B	39,450-39,500
5-A	38,800-38,850	5-B	39,500-39,550
6-A	38,850-38,900	6-B	39,550-39,600
7-A	38,900-38,950	7-B	39,600-39,650
8-A	38,950-39,000	8-B	39,650-39,700
9-A	39,000-39,050	9-B	39,700-39,750
10-A	39,050-39,100	10-B	39,750-39,800
11-A	39,100-39,150	11-B	39,800-39,850
12-A	39,150-39,200	12-B	39,850-39,900
13-A	39,200-39,250	13-B	39,900-39,950
14-A	39,250-39,300	14-B	39,950-40,000

(c) 37-38.6 GHz band: 37,000-37,533 MHz; 37,534-38,066 MHz; and 38,067-38,600 MHz.

### **§ 30.5 Service Areas.**

(a) Except as noted in paragraphs (b) and (c), the service areas for the Upper Microwave Flexible Use Service are counties.

(b) Common Carrier Fixed Point-to-Point Microwave Stations licensed in the 38.6-40 GHz bands licensed with Rectangular Service Areas shall maintain their Rectangular Service Area as defined in their authorization. The frequencies associated with Rectangular Service Area authorizations that have expired, cancelled, or otherwise been recovered by the Commission will automatically revert to the applicable county licensee.

(c) Upper Microwave Flexible Use authorizations issued pursuant to a special filing window for Holders of Fixed Satellite Service earth stations shall have a service area consisting of the census tract within which the relevant earth station is located.

### **§ 30.6 Permissible Communications.**

(a) Except as noted in paragraphs (b) and (c) below, a licensee in the frequency bands specified in § 30.4 may provide any services for which its frequency bands are allocated, as set forth in the non-Federal Government column of the Table of Allocations in § 2.106 of this chapter (column 5).

(b) County licenses in the 37-38.6 GHz band shall not authorize local area operations. Such local area operations shall be authorized pursuant to the provisions of § 30.102.

(c) Fixed Satellite Service shall be provided in a manner consistent with part 25 of this chapter.

## **Subpart B – Applications and Licenses**

### **§ 30.101 Initial Authorizations.**

Except with respect to local area operations in the 37-38.6 GHz band, an applicant must file a single application for an initial authorization for all markets won and frequency blocks desired. Initial authorizations shall be granted in accordance with § 30.4. Applications for individual sites are not required and will not be accepted, except where required for environmental assessments, in accordance with §§ 1.1301 through 1.1319 of this chapter.

### **§ 30.102 Authorization of Operation of Local Area Networks in 37-38.6 GHz Band.**

Any party who meets the eligibility requirements in § 30.3 may operate local area operations in the 37-38.6 GHz band within the boundaries of property they own.

### **§ 30.103 Transition of Existing Local Multipoint Distribution Service and 39 GHz Licenses.**

Local Multipoint Distribution Service licenses issued on a Basic Trading Area basis and 39 GHz licenses issued on an Economic Area basis shall be disaggregated into county-based licenses on **[insert effective date of rule]**. For each county in the Basic Trading Area or Economic Area which is part of the original license, the licensee shall receive a separate license. If there is a Rectangular Service Area licensee within the service area of a 39 GHz Economic Area licensee, the disaggregated license shall not authorize operation with the service area of the Rectangular Service Area license.

**§ 30.104 License Term.**

Initial authorizations will have a term not to exceed ten years from the date of initial issuance or renewal.

**§ 30.105 Construction Requirements**

(a) Upper Microwave Flexible Use Service licensees must make a buildout showing as part of their renewal applications. Licensees providing mobile, point-to-multipoint, or point-to-point service, must demonstrate that they are providing reliable signal coverage and service to at least 40 percent of the population within the service area of the licensee, and that they are using facilities to provide service in that area either to customers or for internal use. In determining the percentage of population covered in each county, the population covered by a licensee's service area will be measured at the census block level, using the centroid of each census block from the most recent U.S. Census. If the total population of the census blocks covered by the licensees reliable signal is 40% or greater the licensee will be deemed to have met the performance requirement. Failure to meet this requirement will result in automatic cancellation of the license.

(b) Existing 39 GHz licensees shall not be required to make a showing pursuant to this rule and shall be governed by the provisions of § 101.17 of this chapter if the expiration date of their license is prior to March 1, 2021.

**§ 30.106 Geographic Partitioning and Spectrum Disaggregation.**

(a) Parties seeking approval for partitioning and disaggregation shall request from the Commission an authorization for partial assignment of a license pursuant to §1.948. Upper Microwave Flexible Use Service licensees may apply to partition their licensed geographic service area or disaggregate their licensed spectrum at any time following the grant of their licenses.

(b) Technical Standards—(1) Partitioning. In the case of partitioning, applicants and licensees must file FCC Form 603 pursuant to section 1.948 and list the partitioned service area on a schedule to the application. The geographic coordinates must be specified in degrees, minutes, and seconds to the nearest second of latitude and longitude and must be based upon the 1983 North American Datum (NAD83).

(2) Spectrum may be disaggregated in any amount.

(3) The Commission will consider requests for partial assignment of licenses that propose combinations of partitioning and disaggregation.

(4) For purposes of partitioning and disaggregation, part 30 systems must be designed so as not to exceed the signal level specified for the particular spectrum block in § 30.204 at the licensee's service area boundary, unless the affected adjacent service area licensees have agreed to a different signal level.

(c) License term. The license term for a partitioned license area and for disaggregated spectrum shall be the remainder of the original licensee's license term as provided for in § 30.104.

(d) (1) Parties to partitioning agreements have two options for satisfying the construction requirements set forth in § 30.105. Under the first option, the partitioner and partitionee each certifies that they will collectively share responsibility for meeting the construction requirement for the entire pre-partition geographic license area. If the partitioner and partitionee collectively fail to meet the construction requirement, then the licenses of both the partitioner and partitionee will automatically

cancel. Under the second option, the partitioner and partitionee each certifies that it will independently meet the construction requirement for its respective partitioned license area. If the partitioner or partitionee fails to meet the construction requirement for its respective partitioned license area, then the relevant license will automatically cancel.

(2) Parties to disaggregation agreements have two options for satisfying the construction requirements set forth in § 30.105. Under the first option, the disaggregator and disaggregatee each certifies that they will collectively share responsibility for meeting the construction requirement for the entire pre-partition geographic license area. If the disaggregator and disaggregatee collectively fail to meet the construction requirement, then the licenses of both the disaggregator and disaggregatee will automatically cancel. Under the second option, the disaggregator and disaggregatee each certifies that it will independently meet the construction requirement for its respective disaggregated license area. If the disaggregator or disaggregatee fails to meet the construction requirement for its respective disaggregated license area, then the relevant license will automatically cancel.

### **§ 30.107 Discontinuance of Service.**

(a) An Upper Microwave Flexible Use License authorization will automatically terminate, without specific Commission action, if the licensee permanently discontinues service after the initial license term.

(b) For licensees with common carrier regulatory status, permanent discontinuance of service is defined as 180 consecutive days during which a licensee does not provide service to at least one subscriber that is not affiliated with, controlled by, or related to the licensee in the individual license area. For licensees with non-common carrier status, permanent discontinuance of service is defined as 180 consecutive days during which a licensee does not operate.

(c) A licensee that holds a 600 MHz band authorization or an AWS authorization in the 1695-1710 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2155-2180 MHz, and 2180-2200 MHz bands, that permanently discontinues service as defined in this section must notify the Commission of the discontinuance within 10 days by filing FCC Form 601 or 605 requesting license cancellation. An authorization will automatically terminate, without specific Commission action, if service is permanently discontinued as defined in this section, even if a licensee fails to file the required form requesting license cancellation.

## **Subpart C – Technical Standards**

### **§ 30.201 Equipment Authorization.**

(a) Each transmitter utilized for operation under this part must be of a type that has been authorized by the Commission under its certification procedure.

(b) Any manufacturer of radio transmitting equipment to be used in these services may request equipment authorization following the procedures set forth in subpart J of part 2 of this chapter. Equipment authorization for an individual transmitter may be requested by an applicant for a station authorization by following the procedures set forth in part 2 of this chapter.

### **§ 30.202 Power Limits.**

(a) For fixed and base stations operating in connection with mobile systems, the power is limited to:

(1) An equivalent isotropically radiated power (EIRP) of 1640 watts when transmitting with an

emission bandwidth of 100 MHz or less, except in rural areas, the maximum EIRP shall be 3280 watts;

(2) An EIRP of 1640 watts/100 MHz when transmitting with an emission bandwidth greater than 100 MHz, except in rural areas, the maximum EIRP shall be 3280 watts/100 MHz.

(b) For fixed stations operating solely in point-to-point and point-to-multipoint modes, the power is limited to a maximum EIRP of +55dBW.

(c) For mobile stations, the power is limited to 20 watts.

#### **§ 30.203 Emission Limits.**

(a) The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in EIRP by at least  $43 + 10 \log_{10}(P)$  dB.

(b) (1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(2) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.

(3) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

#### **§ 30.204 Field Strength Limits.**

The predicted or measured median field strength at any location on the geographical border of a licensee's service area shall not exceed 47 dB $\mu$ V/m unless the adjacent affected service area licensee(s) agree(s) to a different field strength. This value applies to both the initially offered service areas and to partitioned service areas.

#### **§ 30.205 Information Sharing Requirements.**

- (a) Each operator of a Fixed Service or Mobile Service system in the 27.5-28.35 GHz or 37.5-40 GHz band will make the technical information about its system listed in subsections (b) and (c) of this section available to FSS operators by one or more of the following means:
- (1) an online database operated by the Upper Microwave Flexible Use licensee;
  - (2) an online database operated by a third-party database manager, or
  - (3) a continuously transmitted pilot signal receivable throughout the terrain within which a FSS facility could cause interference to or receive interference from the terrestrial system.
- (b) All licensees deploying fixed systems in the 27.5-28.35 GHz or 37.5-40 GHz bands will make the following information about each such system available to FSS operators in those bands by one or more of the means described in subsection (a) of this section:

Licensee's name and address.

Transmitting station name.

Transmitting station coordinates.

Frequencies and polarizations.

Transmitting equipment, its stability, effective isotropic radiated power, emission designator, and type of modulation (digital).

Transmitting antenna(s), model, gain, and a radiation pattern provided or certified by the manufacturer.

Transmitting antenna center line height(s) above ground level and ground elevation above mean sea level.

Transmitting antenna boresight(s) angle of elevation with respect to the horizon.

Receiving station name.

Receiving station coordinates.

Receiving antenna(s), model, gain, and, if required, a radiation pattern provided or certified by the manufacturer.

Receiving antenna center line height(s) above ground level and ground elevation above mean sea level.

Receiving antenna boresight(s) angle of elevation with respect to the horizon.

Path azimuth and distance.

- (c) All licensees deploying mobile service base stations in the 27.5-28.35 GHz or 37.5-40 GHz bands will make the following information about each such base station available to FSS operators by one or both of the means described in subsection (a) of this section:

Licensee's name and address.

Transmitting station name.

Transmitting station coordinates.

Frequencies and polarizations.

Transmitting equipment, its stability, maximum effective isotropic radiated power, emission designator, and types of modulation.

Transmitting antenna(s), model, maximum gain, and maximum extent of all possible radiation patterns provided or certified by the manufacturer.

Transmitting antenna center line height(s) above ground level and ground elevation above mean sea level.

Transmitting antenna boresight(s) maximum and minimum angles of elevation with respect to the horizon.

Transmitting antenna boresight minimum and maximum azimuths, or designation of omnidirectionality.

Boundary of the area served by the base station for purposes of communication with mobile user equipment.

Receiving antenna(s), model, gain, and maximum extent of all possible radiation patterns provided or certified by the manufacturer.

Receiving antenna center line height(s) above ground level and ground elevation above mean sea level.

Receiving antenna boresight maximum and minimum angles of elevation with respect to the horizon.

Receiving antenna boresight minimum and maximum azimuths, or designation of omnidirectionality.

#### **§ 30.206 Federal Coordination Requirements.**

Licensees in the 37-38 GHz band must protect co-channel Space Research Service (space-to-Earth) facilities from interference. Upper Microwave Flexible Use Licensees licensed in the 37-38 GHz band operating near Space Research Service facilities must coordinate any operations that could permit mobile, fixed, and portable stations to operate near those facilities.

#### **§ 30.207 International Coordination.**

Operations in the 27.5-28.35 GHz and 38.6-40 GHz bands are subject to international agreements with Canada and Mexico.

#### **§ 30.208 RF Safety.**

Licensees and manufacturers are subject to the radio frequency radiation exposure requirements specified in § 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

#### **§ 30.209 Interoperability.**

(a) Mobile and portable stations that operate on any portion of frequencies within the 27.5-28.35 GHz or the 37-40 GHz bands must be capable of operating on all frequencies within those particular bands using the same air interfaces that the equipment utilizes on any frequencies in the 27.5-28.35 GHz or the 37-40 GHz bands, respectively.

(b) The basic interoperability requirement in paragraph (a) of this section does not require a licensee to use any particular industry standard. Devices may also contain functions that are not operational in U.S. Territories.

**Subpart D – Competitive Bidding Procedures****§ 30.301 Upper Microwave Flexible Use Service Subject to Competitive Bidding.**

Mutually exclusive initial applications for 38.6-40.0 GHz band licenses are subject to competitive bidding. The general competitive bidding procedures set forth in part 1, subpart Q of this chapter will apply unless otherwise provided in this subpart.

**§ 30.302 Designated Entities and Bidding Credits.**

(a) A winning bidder that qualifies as a small business and has not claimed a rural service provider bidding credit may use the bidding credits set forth in § 1.2110(f)(2) of Part 1 of this chapter, except that the 35 percent bidding credit in § 1.2110(f)(2)(A) of Part 1 of this chapter shall not be available.

(b) A rural service provider (as defined in § 1.2110(f)(4) of Part 1 of this chapter who has not claimed a small business bidding credit will be eligible to receive a 15 percent bidding credit.

**PART 101 – FIXED MICROWAVE SERVICES**

14. The authority citation for Part 101 continues to read as follows:

AUTHORITY: 47 U.S.C. 154, 303.

15. Amend 101.17 by adding paragraph (c) to read as follows:

**§101.17 Performance requirements for the 38.6-40.0 GHz frequency band.**

\* \* \* \* \*

(c) Existing 39 GHz licensees shall not be required to make a showing pursuant to this rule if the expiration date of their license is after March 1, 2021.

16. Remove and reserve § 101.56.

**§ 101.56 [Removed and reserved].**

17. Amend § 101.63 by amending paragraph (a) to read as follows:

**§101.63 Period of construction; certification of completion of construction.**

(a) Each Station, except in Multichannel Video Distribution and Data Service, Local Multipoint Distribution Service, and the 24 GHz Service, authorized under this part must be in operation within 18 months from the initial date of grant.

\* \* \* \* \*

18. Amend § 101.101 by amending the table to remove the entries “27,500-28,350” and “38,600-40,000” to read as follows:

**§101.101 Frequency availability.**

Frequency band (MHz)	Radio service				Notes
	Common carrier (Part 101)	Private radio (Part 101)	Broadcast auxiliary (Part 74)	Other (Parts 15, 21, 22, 24, 25, 74, 78 & 100)	
*****					
24,250-25,250	CC	OFS			
29,100-29,250	LMDS	LMDS		SAT	
31,000-31,300	CC LMDS LTTS	OFS LMDS			F/M/TF.
71,000-76,000	CC	OFS		25	F/M/TF
*****					

19. Amend § 101.103 by amending paragraph (g)(1) and removing paragraph (i) to read as follows:

**§101.103 Frequency coordination procedures.**

\*\*\*\*\*

(g) \*\*\*

(1) When the transmitting facilities in a Basic Trading Area (BTA) are to be operated in the bands 29,100-29,250 MHz and 31,000-31,300 MHz and the facilities are located within 20 kilometers of the boundaries of a BTA, each licensee must complete the frequency coordination process of paragraph (d)(2) of this section with respect to neighboring BTA licensees that may be affected by its operations prior to initiating service. In addition, all licensed transmitting facilities operating in the bands 31,000-31,075 MHz and 31,225-31,300 MHz and located within 20 kilometers of neighboring facilities must complete the frequency coordination process of paragraph (d)(2) of this section with respect to such authorized operations before initiating service.

\*\*\*\*\*

(i) [Removed]

20. Amend § 101.107 by amending paragraph (a) by amending the table to remove the entry “27,500-28,350” to read as follows:

**§101.107 Frequency tolerance.**

(a) \*\*\*

Frequency (MHz)	Frequency tolerance (percent)
*****	

19,700 to 27,500 <sup>4 7</sup>	0.001
29,100 to 29,250	0.001
* * * * *	

21. Amend § 101.109 by amending the table in paragraph (c) to remove the entries “27,500-28,350” and “38,600-40,000” and amending footnote 7 to the table to read as follows:

**§101.109 Bandwidth.**

\* \* \* \* \*

(c) \* \* \*

Frequency band (MHz)	Maximum authorized bandwidth
* * * * *	
24,250 to 25,250	40 MHz <sup>7</sup>
29,100 to 29,250	150 MHz
31,000 to 31,075	75 MHz
31,075 to 31,225	150 MHz
31,225 to 31,300	75 MHz
71,000 to 76,000	5000 MHz
* * * * *	

\* \* \* \* \*

<sup>7</sup>For channel block assignments in the 24,250-25,250 MHz band, the authorized bandwidth is equivalent to an unpaired channel block assignment or to either half of a symmetrical paired channel block assignment. When adjacent channels are aggregated, equipment is permitted to operate over the full channel block aggregation without restriction.

\* \* \* \* \*

22. Amend § 101.113 by amending the table in paragraph (a) to read as follows:

**§101.113 Transmitter power limitations.**

(a) \* \* \*

Frequency band (MHz)	Maximum allowable EIRP <sup>1 2</sup>	
	Fixed <sup>1 2</sup> (dBW)	Mobile (dBW)
* * * * *		
24,250-25,250	<sup>5</sup> + 55	

29,100-29,250	(7)	
*****		
31,225 to 31,300 <sup>8,9</sup>	30 dBW/MHz	30 dBW/MHz
71,000-76,000 <sup>13</sup>	+ 55	+ 55
*****		

23. Amend § 101.115 by amending the table in paragraph (b)(2) to read as follows:

**§ 101.115 Directional antennas.**

\*\*\*\*\*

(b) \*\*\*

(2) \*\*\*

Frequency	Category	Maximum beam-width to 3 dB points <sup>1</sup> (included angle in degrees)	Minimum antenna Gain (dBi)	<i>Minimum radiation suppression to angle in degrees from centerline of main beam in decibels</i>						
				5° to 10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
*****										
31,000 to 31,300 <sup>12,13</sup>	n/a	4.0	38	n/a	n/a	n/a	n/a	n/a	n/a	n/a
71,000 to 76,000 (co-polar) <sup>15</sup>	N/A	1.2	43	35	40	45	50	50	55	55
*****										

<sup>14</sup> [Reserved].

24. Amend § 101.147 by amending paragraphs (a) and (t) and reserving paragraph (v) to read as follows:

**§101.147 Frequency assignments.**

(a) Frequencies in the following bands are available for assignment for fixed microwave services.

928.0-929.0 MHz (28)  
 932.0-932.5 MHz (27)  
 932.5-935 MHz (17)  
 941.0-941.5 MHz (27)  
 941.5-944 MHz (17) (18)  
 952.0-960.0 MHz (28)  
 1,850-1,990 MHz (20) (22)  
 2,110-2,130 MHz (1) (3) (7) (20) (23)  
 2,130-2,150 MHz (20) (22)  
 2,160-2,180 MHz (1) (2) (20) (23)  
 2,180-2,200 MHz (20) (22)  
 2,450-2,500 MHz (12)  
 2,650-2,690 MHz  
 3,700-4,200 MHz (8) (14) (25)  
 5,925-6,425 MHz (6) (14) (25)  
 6,425-6,525 MHz (24)  
 6,525-6.875 MHz (14) (33)  
 6,875-7,125 MHz (10), (34)  
 10,550-10,680 MHz (19)  
 10,700-11,700 MHz (8) (9) (19) (25)  
 11,700-12,200 MHz (24)  
 12,200-12,700 MHz (31)  
 12,700-13,200 (22), (34)  
 13,200-13,250 MHz (4) (24) (25)  
 14,200-14,400 MHz (24)  
 17,700-18,820 MHz (5) (10) (15)  
 17,700-18,300 MHz (10) (15)  
 18,820-18,920 MHz (22)  
 18,300-18,580 MHz (5) (10) (15)  
 18,580-19,300 MHz (22) (30)  
 18,920-19,160 MHz (5) (10) (15)  
 19,160-19,260 MHz (22)  
 19,260-19,700 MHz (5) (10) (15)  
 19,300-19,700 MHz (5) (10) (15)  
 21,200-22,000 MHz (4) (11) (12) (13) (24) (25) (26)  
 22,000-23,600 MHz (4) (11) (12) (24) (25) (26)  
 24,250-25,250 MHz  
 29,100-29,250 MHz (5), (16)  
 31,000-31,300 MHz (16)  
 42,000-42,500 MHz  
 71,000-76,000 MHz (5) (17)  
 81,000-86,000 MHz (5) (17)  
 92,000-94,000 MHz (17)  
 94,100-95,000 MHz (17)

\* \* \* \* \*

(t) *29,100-29,250; 31,000-31,300 MHz.* These frequencies are available for LMDS systems. Each assignment will be made on a BTA service area basis, and the assigned spectrum may be subdivided as desired by the licensee.

\* \* \* \* \*

(v) [Reserved.]

25. Remove and reserve § 101.149.

**§ 101.149 [Removed and reserved].**

26. Amend § 101.1005 by amending paragraphs (a) and (b) to read as follows:

**§101.1005 Frequencies available.**

(a) The following frequencies are available for assignment to LMDS in two license blocks:

*Block A of 300 MHz*

29,100-29,250 MHz

31,075-31,225 MHz

*Block B of 150 MHz*

31,000-31,075 MHz

31,225-31,300 MHz

(b) In Block A licenses, the frequencies are authorized as follows:

(1) 29,100-29,250 MHz is shared on a co-primary basis with feeder links for non-geostationary orbit Mobile Satellite Service (NGSO/MSS) systems in the band and is limited to LMDS hub-to-subscriber transmissions, as provided in §§25.257 and 101.103(h).

(2) 31,075-31,225 MHz is authorized on a primary protected basis and is shared with private microwave point-to-point systems licensed prior to March 11, 1997, as provided in §101.103(b).

\* \* \* \* \*

27. Remove and reserve Subpart N of this part.

**Subpart N—Competitive Bidding Procedures for the 38.6-40.0 GHz Band** [Reserved.]

## APPENDIX B

## Initial Regulatory Flexibility Analysis

1. As required by the Regulatory Flexibility Act of 1980, as amended (RFA),<sup>1</sup> the Commission has prepared this present Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on a substantial number of small entities by the policies and rules proposed in this *Notice of Proposed Rulemaking (NPRM)*. Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines specified in the *NPRM* for comments. The Commission will send a copy of this *NPRM*, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).<sup>2</sup> In addition, the *NPRM* and IRFA (or summaries thereof) will be published in the Federal Register.<sup>3</sup>

**A. Need for, and Objectives of, the Proposed Rules**

2. In this *Notice of Proposed Rulemaking*, we propose to authorize mobile operations in the 27.5-28.35 GHz band (28 GHz band), the 38.6-40 GHz band (39 GHz band), and the 37-38.6 GHz band (37 GHz band). These bands are known collectively as the mmW bands.

3. Until recently, the mmW bands were generally considered unsuitable for mobile applications because of propagation losses at such high frequencies and the inability of mmW signals to propagate around obstacles. As increasing congestion has begun to fill the lower bands and carriers have resorted to smaller and smaller microcells in order to re-use the available spectrum, however, industry is taking another look at the mmW bands and beginning to realize that at least some of its presumed disadvantages can be turned to advantage. First and foremost, the perceived unsuitability of mmW frequencies for mobile and other applications have not been considered as potential spectrum for wide-bandwidth, broadband operations whenever technology becomes available to exploit those under-used resources. As discussed further below, short transmission paths and high propagation losses can facilitate spectrum re-use in microcellular deployments by limiting the amount of interference between adjacent cells. Where longer paths are desired, however, the extremely short wavelengths of mmW signals make it feasible for very small antennas to concentrate signals into highly focused beams with enough gain to overcome propagation losses. Also, the short wavelengths of mmW signals also make it possible to build multi-element, dynamic beam-forming antennas that will be small enough to fit into handsets—a feat that might never be possible at the lower, longer-wavelength frequencies below 6 GHz where cell phones operate today.

4. In the 28 GHz, 39 GHz, and 37 GHz bands, we propose to create a new radio service in a new rule part that would authorize fixed and mobile services. The additional spectrum for mobile use will help ensure that the speed, capacity, and ubiquity of the nation's wireless networks keeps pace with the skyrocketing demand for mobile service. It could also make possible new types of services for consumers and businesses.

5. For the 28 GHz and 39 GHz bands, we propose to assign licenses by competitive bidding using counties as the area for geographic area licensing. We also propose to transition existing licensees in these bands to county-based licenses. For the 37 GHz, we propose a hybrid licensing scheme in which rights to local area operations tailored to physical facility boundaries would be assigned by rule and rights to outdoor operations would be assigned by geographic area licensing using counties as the geographic

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<sup>1</sup> See 5 U.S.C. § 603. The RFA, *see* 5 U.S.C. § 601-612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996, (SBREFA) Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

<sup>2</sup> See 5 U.S.C. § 603(a).

<sup>3</sup> See 5 U.S.C. § 603(a).

unit. This hybrid mechanism could facilitate the development of advanced enterprise and industrial applications not suited to unlicensed spectrum or public network services.

6. These service rules would make available additional spectrum for flexible use. In proposing service rules for the band, which include technical rules to protect against harmful interference, licensing rules to establish geographic license areas and spectrum block sizes, and performance requirements to promote robust buildout, we advance toward enabling rapid and efficient deployment. We do so by proposing flexible service, technical, assignment, and licensing rules for this spectrum, except where special provisions are necessary to facilitate shared use with other co-primary users.

7. At the same time, because the 28 GHz, 39 GHz, and 37 GHz bands are shared with satellite services, we also seek comment on ways to facilitate satellite uses that are consistent with fixed and mobile use of the bands. Specifically, we propose a mechanism under which 28 GHz gateway earth stations could obtain co-primary status if their presence would not impede terrestrial development. We also ask if there are circumstances under which satellite user equipment could be authorized in these bands on a secondary basis.

8. We also propose to authorize unlicensed operation pursuant to Part 15 of our rules in the 64-71 GHz band. The proposed technical rules would be based on our existing rules for the 57-64 GHz band.

9. Overall, these proposals are designed to provide for flexible use of this spectrum by allowing licensees to choose their type of service offerings, to encourage innovation and investment in mobile broadband use in this spectrum, and to provide a stable regulatory environment in which fixed, mobile, and satellite deployment would be able to develop through the application of flexible rules. The market-oriented licensing framework for these bands would ensure that this spectrum is efficiently utilized and will foster the development of new and innovative technologies and services, as well as encourage the growth and development of a wide variety of services, ultimately leading to greater benefits to consumers.

## **B. Legal Basis**

10. The proposed action is authorized pursuant to s Sections 1, 2, 3, 4, 5, 7, 10, 201, 225, 227, 301, 302, 302a, 303, 304, 307, 309, 310, 316, 319, 332, and 336 of the Communications Act of 1934, 47 U.S.C. §§ 151, 152, 153, 154, 155, 157, 160, 201, 225, 227, 301, 302, 302a, 303, 304, 307, 309, 310, 316, 319, 332, 336 and Section 706 of the Telecommunications Act of 1996, as amended, 47 U.S.C. § 1302.

## **C. Description and Estimate of the Number of Small Entities To Which the Proposed Rules Will Apply**

11. The RFA directs agencies to provide a description of, and, where feasible, an estimate of the number of small entities that may be affected by the proposed rules and policies, if adopted.<sup>4</sup> The RFA generally defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”<sup>5</sup> In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.<sup>6</sup> A “small

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<sup>4</sup> 5 U.S.C. § 603(b)(3).

<sup>5</sup> 5 U.S.C. § 601(6).

<sup>6</sup> 5 U.S.C. § 601(3) (incorporating by reference the definition of “small-business concern” in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies “unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity

(continued....)

business concern” is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the SBA.<sup>7</sup>

12. *Small Businesses, Small Organizations, and Small Governmental Jurisdictions.* Our action may, over time, affect small entities that are not easily categorized at present. We therefore describe here, at the outset, three comprehensive, statutory small entity size standards.<sup>8</sup> First, nationwide, there are a total of approximately 28.2 million businesses, 99.7 percent of which are small, according to the SBA.<sup>9</sup> In addition, a “small organization” is generally “any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.”<sup>10</sup> Nationwide, as of 2007, there were approximately 1,621,315 small organizations.<sup>11</sup> Finally, the term “small governmental jurisdiction” is defined generally as “governments of cities, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.”<sup>12</sup> Census Bureau data for 2011 indicate that there were 89,476 local governmental jurisdictions in the United States.<sup>13</sup> We estimate that, of this total, as many as 88,506 entities may qualify as “small governmental jurisdictions.”<sup>14</sup> Thus, we estimate that most governmental jurisdictions are small.

13. *Wireless Telecommunications Carriers (except satellite).* The appropriate size standard under SBA rules is for the category Wireless Telecommunications Carriers. Under that size standard, such a business is small if it has 1,500 or fewer employees.<sup>15</sup> Census Bureau data for 2011, show that there were 10,145 firms in this category that operated for the entire year. Of this total, 10,117 had employment of 999 or fewer, and 28 firms had employment of 1,000 employees or more. Thus under this category and the associated small business size standard, the Commission estimates that the majority of wireless telecommunications carriers (except satellite) are small entities that may be affected by our proposed action.<sup>16</sup>

(Continued from previous page) \_\_\_\_\_

for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register.”

<sup>7</sup> 15 U.S.C. § 632.

<sup>8</sup> See 5 U.S.C. §§ 601(3)–(6).

<sup>9</sup> See SBA, Office of Advocacy, “Frequently Asked Questions,” available at [https://www.sba.gov/sites/default/files/FAQ\\_March\\_2014\\_0.pdf](https://www.sba.gov/sites/default/files/FAQ_March_2014_0.pdf).

<sup>10</sup> 5 U.S.C. § 601(4).

<sup>11</sup> INDEPENDENT SECTOR, THE NEW NONPROFIT ALMANAC & DESK REFERENCE (2010).

<sup>12</sup> 5 U.S.C. § 601(5).

<sup>13</sup> U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES: 2011, Table 427.

<sup>14</sup> The 2007 U.S. Census data for small governmental organizations are not presented based on the size of the population in each such organization. There were 89,476 small governmental organizations in 2007. If we assume that county, municipal, township, and school district organizations are more likely than larger governmental organizations to have populations of 50,000 or less, the total of these organizations is 52,125. If we make the same assumption about special districts and also assume that special districts are different from county, municipal, township, and school districts, in 2007 there were 37,381 special districts. Therefore, of the 89,476 small governmental organizations documented in 2007, as many as 89,506 may be considered small under the applicable standard. This data may overestimate the number of such organizations that has a population of 50,000 or less. U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES 2011, Tables 427, 426 (Data cited therein are from 2007).

<sup>15</sup> 13 C.F.R. § 121.201, NAICS code 517210.

<sup>16</sup> See [http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP\\_2011\\_00A3&prodType=table](http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP_2011_00A3&prodType=table).

14. *Fixed Microwave Services.* Microwave services include common carrier,<sup>17</sup> private-operational fixed,<sup>18</sup> and broadcast auxiliary radio services.<sup>19</sup> They also include the Local Multipoint Distribution Service (LMDS),<sup>20</sup> the Digital Electronic Message Service (DEMS),<sup>21</sup> the 39 GHz Service (39GHz),<sup>22</sup> the 24 GHz Service,<sup>23</sup> and the Millimeter Wave Service<sup>24</sup> where licensees can choose between common carrier and non-common carrier status.<sup>25</sup> At present, there are approximately 61,970 common carrier fixed licensees, 62,909 private and public safety operational-fixed licensees, 20,349 broadcast auxiliary radio licensees, 412 LMDS licenses, 35 DEMS licenses, 870 39GHz licenses, 5 24GHz licenses, and 408 Millimeter Wave licenses in the microwave services.<sup>26</sup> The Commission has not yet defined a small business with respect to microwave services. For purposes of the IRFA, the Commission will use the SBA's definition applicable to Wireless Telecommunications Carriers (except satellite)—i.e., an entity with no more than 1,500 persons is considered small.<sup>27</sup> Under that size standard, such a business is small if it has 1,500 or fewer employees.<sup>28</sup> Census Bureau data for 2011, show that there were 10,145 firms in this category that operated for the entire year. Of this total, 10,117 had employment of 999 or fewer, and 28 firms had employment of 1,000 employees or more. Thus under this category and the associated small business size standard, the Commission estimates that the majority of wireless telecommunications carriers (except satellite) are small entities that may be affected by our proposed action.<sup>29</sup> The Commission notes that the number of firms does not necessarily track the number of licensees. The Commission estimates that virtually all of the Fixed Microwave licensees (excluding broadcast auxiliary licensees) would qualify as small entities under the SBA definition.

15. *Satellite Telecommunications and All Other Telecommunications.* Two economic census categories address the satellite industry. The first category has a small business size standard of \$32.5

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<sup>17</sup> See 47 C.F.R. Part 10, Subpart I.

<sup>18</sup> Persons eligible under Parts 80 and 90 of the Commission's rules can use Private-Operational Fixed Microwave services. See 47 C.F.R. Parts 80 and 90. Stations in this service are called operational-fixed to distinguish them from common carrier and public fixed stations. Only the licensee may use the operational-fixed station, and only for communications related to the licensee's commercial, industrial, or safety operations.

<sup>19</sup> Auxiliary Microwave Service is governed by Part 74 and Part 78 of Title 47 of the Commission's rules. Available to licensees of broadcast stations, cable operators, and to broadcast and cable network entities. Auxiliary microwave stations are used for relaying broadcast television signals from the studio to the transmitter, or between two points such as a main studio and an auxiliary studio. The service also includes TV pickup and CARS pickup, which relay signals from a remote location back to the studio.

<sup>20</sup> See 47 C.F.R. Part 101, Subpart L.

<sup>21</sup> See 47 C.F.R. Part 101, Subpart G.

<sup>22</sup> See 47 C.F.R. Part 101, Subpart N.

<sup>23</sup> See *id.*

<sup>24</sup> See 47 C.F.R. Part 101, Subpart Q.

<sup>25</sup> See 47 C.F.R. §§ 101.533, 101.1017.

<sup>26</sup> These statistics are based on a review of the Universal Licensing System on September 22, 2015.

<sup>27</sup> 13 C.F.R. § 121.201, NAICS code 517210.

<sup>28</sup> 13 C.F.R. § 121.201, NAICS code 517210.

<sup>29</sup> See

[http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP\\_2011\\_00A3&prodType=table](http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP_2011_00A3&prodType=table).

million or less in average annual receipts, under SBA rules.<sup>30</sup> The second also has a size standard of \$32.5 million or less in annual receipts.<sup>31</sup>

16. The category of Satellite Telecommunications “comprises establishments primarily engaged in providing telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.”<sup>32</sup> Census Bureau data for 2011 show that 659 Satellite Telecommunications firms operated for that entire year.<sup>33</sup> Of this total, 464 firms had annual receipts of under \$10 million, and 18 firms had receipts of \$10 million to \$24,999,999.<sup>34</sup> Consequently, the Commission estimates that the majority of Satellite Telecommunications firms are small entities that might be affected by our action.

17. The second category, *i.e.* “All Other Telecommunications” comprises “establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation. This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems. Establishments providing Internet services or voice over Internet protocol (VoIP) services via client-supplied telecommunications connections are also included in this industry.”<sup>35</sup> For this category, Census Bureau data for 2012 show that there were a total of 2,981 firms that operated for the entire year.<sup>36</sup> Of this total, 2,347 firms had annual receipts of under \$25 million and 12 firms had annual receipts of \$25 million to \$49,999,999.<sup>37</sup> Consequently, the Commission estimates that the majority of All Other Telecommunications firms are small entities that might be affected by our action.

18. *Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing.* The proposed rules relating to Part 15 operation pertain to manufacturers of unlicensed communications devices. The Census Bureau defines this category as follows: “This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.”<sup>38</sup> The SBA has developed a small business size standard for firms in this category, which is: all such firms having

<sup>30</sup> 13 C.F.R. § 121.201, NAICS code 517410.

<sup>31</sup> 13 C.F.R. § 121.201, NAICS code 517919.

<sup>32</sup> U.S. Census Bureau, 2012 NAICS Definitions, “517410 Satellite Telecommunications.”

<sup>33</sup> See

[http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP\\_2011\\_00A1&prodType=table](http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP_2011_00A1&prodType=table).

<sup>34</sup> See [http://factfinder.census.gov/servlet/IBQTable?\\_bm=y&-geo\\_id=&-skip=900&-ds\\_name=EC0751SSSZ4&-lang=en](http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en).

<sup>35</sup> U.S. Census Bureau, 2012 NAICS Definitions, “517919 All Other Telecommunications.”

<sup>36</sup> See

[http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP\\_2011\\_00A1&prodType=table](http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP_2011_00A1&prodType=table).

<sup>37</sup> [http://factfinder.census.gov/servlet/IBQTable?\\_bm=y&-geo\\_id=&-skip=900&-ds\\_name=EC0751SSSZ4&-lang=en](http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en).

<sup>38</sup> See U.S. Census Bureau, 2012 NAICS Definitions, NAICS Code 334220, available at [http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ECN\\_2012\\_US\\_31SA1&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ECN_2012_US_31SA1&prodType=table).

750 or fewer employees. According to Census Bureau data for 2007, there were a total of 939 establishments in this category that operated for part or all of the entire year. Of this total, 784 had less than 500 employees and 155 had more than 100 employees.<sup>39</sup> Thus, under this size standard, the majority of firms can be considered small.

#### **D. Description of Projected Reporting, Recordkeeping, and other Compliance Requirements**

19. The projected reporting, recordkeeping, and other compliance requirements proposed in the *Notice of Proposed Rulemaking* will apply to all entities in the same manner. The Commission believes that applying the same rules equally to all entities in this context promotes fairness. The Commission does not believe that the costs and/or administrative burdens associated with the proposed rules will unduly burden small entities, as discussed below. The revisions the Commission adopts should benefit small entities by giving them more information, more flexibility, and more options for gaining access to wireless spectrum.

20. Any applicants for Upper Microwave Flexible Use Service licenses will be required to file license applications using the Commission's automated Universal Licensing System (ULS). ULS is an online electronic filing system that also serves as a powerful information tool, one that enables potential licensees to research applications, licenses, and antenna structures. It also keeps the public informed with weekly public notices, FCC rulemakings, processing utilities, and a telecommunications glossary. Upper Microwave Flexible Use Service applicants that must submit long-form license applications must do so through ULS using Form 601,<sup>40</sup> FCC Ownership Disclosure Information for the Wireless Telecommunications Services using FCC Form 602,<sup>41</sup> and other appropriate forms.<sup>42</sup>

21. Applicants in the Upper Microwave Flexible Use Service will be required to meet buildout requirements at the end of their initial license terms. In doing so, they will be required to provide information to the Commission on the facilities they have constructed, the nature of the service they are providing, and the extent to which they are providing coverage in their license area.

22. We also propose to require Upper Microwave Flexible Use Service licensees to provide information on their proposed operations in order to facilitate sharing with other authorized services. We seek comment on the scope of the information to be provided and the manner in which it should be provided.

#### **E. Steps taken to Minimize Significant Economic Impact on Small Entities, and Significant Alternatives Considered**

23. The proposal in the *NPRM* to license the 28 GHz, 39 GHz bands using county-sized licenses. We also propose to assign outdoor rights in the 37 GHz band using county size licenses. These license areas are small enough to provide spectrum access opportunities for smaller carriers. County license areas also nest within and may be aggregated up to larger license areas. Therefore, the benefits and burdens resulting from assigning spectrum in county license areas are equivalent for small and large businesses. Depending on the licensing mechanism we adopt, licensees may adjust their geographic coverage through auction or, as we discuss in section IV.E.8 of the *NPRM*, through secondary markets. This proposal should enable providers, or any entities, whether large or small, providing service in the

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<sup>39</sup> *See id.*

<sup>40</sup> 47 C.F.R. § 1.913(a)(1).

<sup>41</sup> 47 C.F.R. § 1.919.

<sup>42</sup> 47 C.F.R. § 1.2107.

mmW bands to more easily adjust their spectrum to build their networks pursuant to individual business plans. As a result, we believe the ability of licensees to adjust spectrum holdings will provide an economic benefit by making it easier for small entities to acquire spectrum or access spectrum.

24. The proposals to facilitate satellite service in the 28 GHz, 39 GHz, and 37 GHz would facilitate service by all Fixed Satellite Service entities, including small entities.

25. The *NPRM* proposal in section IV.E.10 pertaining to how the mmW band licenses will be assigned includes proposals to assist small entities in competitive bidding. We propose that the Commission would conduct any auction for licenses for spectrum in the mmW bands in conformity with the general competitive bidding rules set forth in Part 1, Subpart Q, of the Commission's rules, and substantially consistent with the competitive bidding procedures that have been employed in previous auctions.<sup>43</sup> Specifically, we propose to employ the Part 1 rules governing competitive bidding design, designated entity preferences, unjust enrichment, application and payment procedures, reporting requirements, and the prohibition on certain communications between auction applicants. Specifically, small entities will benefit from the proposal to provide small businesses with a bidding credit of 15 percent and very small businesses with a bidding credit of 25 percent. Providing small businesses and very small businesses with bidding credits will provide an economic benefit to small entities by making it easier for small entities to acquire spectrum or access to spectrum in these bands.

26. In section IV.F of the *NPRM*, the Commission proposes service rules that permit a licensee to employ the spectrum for any non-Federal fixed or mobile use, subject to the Commission's proposed Part 30 flexible use and other applicable rules (including service rules to avoid harmful interference). The technical rules we propose or seek comment on will allow licensees of mmW band spectrum to operate while also protecting licensees of nearby spectrum, some of whom are small entities, from harmful interference.

27. We propose to permit partitioning and disaggregation by licensees in the mmW bands.<sup>44</sup> These secondary market rules apply equally to all entities, whether small or large. We believe the opportunity to enter into secondary market agreements for mmW band spectrum will provide an economic benefit to all entities, whether large or small. Therefore, the benefits and burdens resulting from secondary market agreements for spectrum are equivalent for small and large businesses.

**F. Federal Rules that May Duplicate, Overlap, or Conflict with the Proposed Rules**

28. None.

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<sup>43</sup> See 47 C.F.R. §§ 1.2101-1.2114.

<sup>44</sup> See Section IV.E.8.a.

## APPENDIX C

List of Commenters to *Spectrum Frontiers NOI***Commenters**

4G Americas  
Akbar Sayeed  
Alcatel-Lucent  
ARRL, the national association for Amateur Radio  
Avanti Communications Group PLC  
Bluwan SA  
Bob Congrove  
Consumer Electronics Association  
CTIA-The Wireless Association  
EchoStar Satellite Operating Corporation, Hughes Network Systems, LLC, Alta Wireless, Inc. (EchoStar)  
Ericsson Inc.  
European Satellite Operators' Association (ESOA)  
FiberTower Spectrum Holdings, LLC  
Fixed Wireless Communications Coalition  
Google Inc.  
Huawei Technologies, Inc. (USA), Huawei Technologies Co., Ltd.  
IEEE 802 LMSC  
Inmarsat  
Intel Corp.  
InterDigital, Inc.  
Iridium Satellite LLC  
James E. Whedbee  
Marcus Spectrum Solutions LLC  
McKay Bros., LLC  
Mobile Future  
Motorola Mobility LLC  
National Academy of Sciences' Committee on Radio Frequencies (CORF)  
National Cable & Telecommunications Association (NCTA)  
National Radio Astronomy Observatory  
Neal S. Lachman  
Nokia (D/B/A Nokia Solutions and Networks US LLC)  
NYU Wireless  
O3b Limited  
Paul Nikolich  
Qualcomm Inc.  
Robert W. Heath Jr.  
Samsung Electronics America, Inc. and Samsung Research America  
Satellite Industry Association  
SES, Intelsat, O3b, and Inmarsat (FSS Operators)  
SiBeam, Inc.  
Straight Path Communications, Inc.  
Telecommunications Industry Association  
The Wireless Innovation Forum  
T-Mobile USA, Inc.  
Verizon  
ViaSat, Inc.  
Vivint Wireless, Inc.

WI-FI Alliance  
XO Communications, LLC

**Reply Commenters**

Angie Communications International B.V.  
AT&T Services Inc.  
EchoStar  
FiberTower Spectrum Holdings, LLC  
Iridium Satellite LLC  
Nokia Solutions and Networks US LLC (D/B/A Nokia)  
NYU Wireless  
O3b Limited  
Open Technology Institute, Public Knowledge  
Samsung Electronics America, Inc. and Samsung Research America  
Satellite Industry Association  
Space Exploration Technologies Corp. (SpaceX)  
Straight Path Communications, Inc.  
ViaSat, Inc.  
Vivint Wireless, Inc.  
XO Communications, LLC

***Ex Parte Filers***

Alcatel-Lucent  
Covington & Burling LLP  
CTIA-The Wireless Association  
Ericsson  
FiberTower Spectrum Holdings, LLC  
Google, Inc.  
Intel Corp.  
Marcus Spectrum Solutions LLC  
Mobile Future  
Nokia (d/b/a Nokia Solutions and Networks US LLC)  
NYU Wireless  
O3b Limited  
Qualcomm Inc.  
Samsung Electronics America and Samsung Research America  
Satellite Industry Association  
The Small UAV Coalition  
Sony Electronics  
Straight Path Communications, Inc.  
Tom Stroup  
ViaSat, Inc.  
Vivint Wireless, Inc.

**STATEMENT OF  
CHAIRMAN TOM WHEELER**

Re: *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, GN Docket No. 14- 177; Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands, IB Docket No. 15-256; Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band, RM-11664; Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 to Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services, WT Docket No. 10-112; Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations, IB Docket No. 97-95*

With today's Spectrum Frontiers NPRM, we take another step to help foster the next evolution in wireless technology and maintain U.S. leadership in wireless. In addition, this item offers a great example of the type of forward-looking policymaking that the fast-moving communications technology sector demands of this agency.

From 2010 to 2012, I had the honor of serving as Chairman of the FCC's Technological Advisory Council, what most people call the TAC. One of our assignments was to identify and anticipate innovations that will spur job creation and economic growth and then formulate actionable policies to enable this innovation. Led by John Leibovitz and Michael Ha, the TAC's Spectrum Frontiers working group embraced this challenge, and their work laid the foundation for today's item.

It's not surprising that multiple TAC working groups focused on seizing the opportunities of mobile broadband. According to Boston Consulting Group, mobile technologies generated \$3.3 Trillion in global revenue last year and were directly responsible for 11 million jobs. In the 21<sup>st</sup> century, leaders of the mobile economy will be leaders of the global economy.

Thanks to great U.S. inventors and entrepreneurs, America is setting the pace in the mobile revolution. The mobile apps economy is a "made-in-the-USA" phenomenon that has already created more than 750,000 U.S. jobs. More than 99 percent of smartphones worldwide run U.S. operating systems, up from about 20 percent in 2009. And the U.S. was the first nation to deploy LTE wireless networks at scale, making America the test bed for early 4G innovation. Roughly half of American mobile subscribers had 4G connections at the end of 2014, compared to 13 percent of subscribers in Europe and 10 percent in Asia.

In the competitive mobile marketplace, standing still means falling behind. We need to be looking to the future of wireless. We need to be looking at 5G.

The development of the next generation of wireless technology—commonly called the fifth-generation or 5G—is already underway around the world. Our expectation is that this new technology will enable a platform that can support multiple uses and users – including high speed fixed and mobile broadband to consumers – but also networked industrial applications, sensors, and an unknowable number of other wirelessly enabled devices. We also expect next generation commercial networks to be fully heterogeneous, leveraging wide area coverage in low bands (including the 600 MHz band) and new, higher frequency bands for densification.

The U.S. led the way in 4G deployment, partly because the FCC identified spectrum for next-generation wireless, largely in the 700 MHz band, and made it available as part of the DTV transition.

We want to build on this great success story and capitalize on the 5G opportunity. This will require an approach that continues to leverage the Commission's flexible use spectrum policies and its efforts to make low-band, mid-band, high-band, licensed (shared and exclusive-use), and unlicensed spectrum available for wireless broadband.

Today, we propose new service, licensing, and technical rules to make some of these available for new, flexible uses, including opportunities for mobile, fixed, unlicensed, satellite, and other uses. Throughout this proceeding, we will continue to work with stakeholders, including mobile, fixed, satellite, and federal users, to help craft rules that allow new technologies to expand and coexist.

We must pay close attention to the security of these future networks, systems and devices. The overarching goal here is to ensure that future networks, systems and devices are designed to be as secure as possible from the start. Security by design assumes, among other things, that the specifications to which new products are designed treat security like any other critical design principle, the FCC seeks to stimulate early security activity among 5G development stakeholders.

At the upcoming World Radiocommunication Conference (WRC), the international community will be deciding which bands will be studied and later identified for advanced mobile use at the next WRC in 2019. The bands we propose are consistent with the U.S. position at WRC, and we are committed to working with domestic and international partners to develop rules for these bands and conduct sharing and compatibility studies. We are thinking globally, and want to work cooperatively with our international counterparts.

We have an opportunity in this proceeding to continue to push our flexible use policies in a way that promotes access, innovation, security, and the development of the next great generation of wireless technology. I encourage all stakeholders to help the United States take advantage of this opportunity.

Thank you to the staff of the Wireless Bureau, the Office of Engineering and Technology, the International Bureau, and the Public Safety and Homeland Security Bureau for their work on this item.

**STATEMENT OF  
COMMISSIONER MIGNON L. CLYBURN**

Re: *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, GN Docket No. 14- 177; Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands, IB Docket No. 15-256; Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band, RM-11664; Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 to Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services, WT Docket No. 10-112; Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations, IB Docket No. 97-95*

Today's NPRM is an important step toward developing a regulatory framework that should go a long way in facilitating Fifth Generation, or 5G, mobile services. Most of the world's commercial mobile networks use frequencies below 6 gigahertz. At this point, the record indicates that there should be little doubt that 5G devices will incorporate some beachfront spectrum below 1 Gigahertz such as the 700 megahertz spectrum we auctioned in 2008 and the 600 megahertz we plan to auction next year.

But the explosive levels of consumer demand necessitate that we start looking for more spectrum higher up the chart. It was once thought that frequencies above 28 gigahertz could not support mobile services because their wavelengths were too short and the signal propagation losses were too high. But industry engineers have now turned these weaknesses into strengths by finding ways to use short wavelengths to build dynamic beam-forming antennas to support high capacity networks that are small enough to fit into handsets. Many expect that these engineering advances will lead to 5G networks that will offer much higher data speeds and substantially lower latency than what commercial mobile services offer today. They also expect that these networks will support sporadic, low-data-rate transmissions needed to deploy machine-to-machine connections, aka, the "Internet of things."

However, technical innovation is not the only reason why we are able to launch this rulemaking today. Our spectrum management policies have evolved. Experiences in the AWS-3 and 3.5 gigahertz proceedings have taught us that it is possible for new commercial users to share spectrum with federal and incumbent operations and that spectrum access system databases can advance such sharing. We have also learned how valuable unlicensed services are. They complement licensed services, serve an ever increasing wide range of consumer needs and contribute billions of dollars to our economy each year. We have learned that if our rules promote flexible, interoperable use of spectrum, we encourage entry by small businesses and expedite deployment of new wireless services to consumers. So I am pleased that we have initiated this rulemaking that builds on spectrum policies that have successfully spurred innovation and competition in the commercial wireless industry.

I commend Roger Sherman, Julie Knapp, Mindel De La Torre and their staffs at the Wireless Telecommunications Bureau, Office of Engineering and Technology, and International Bureau for presenting such a detailed and thoughtful item.

**STATEMENT OF  
COMMISSIONER JESSICA ROSENWORCEL**

Re: *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, GN Docket No. 14- 177; Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands, IB Docket No. 15-256; Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band, RM-11664; Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 to Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services, WT Docket No. 10-112; Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations, IB Docket No. 97-95*

Our mobile economy is growing—fast. We are moving from networks designed for analog voice to networks designed for high-speed digital data. Add to this the emerging possibilities for viewing ultra-HD videos on tablets and televisions. Then consider self-driving cars and the Internet of Things are around the bend, featuring billions of machines with sensors relying on a steady stream of data delivered wirelessly. Stand back, and you can see that the demands on our airwaves are growing at a breathtaking pace with no end in sight.

To meet these future demands, we need to think differently about spectrum and wireless infrastructure. Today, the bulk of our 4G wireless networks are built on spectrum frequencies from 600 MHz to 3 GHz. This is our current sweet spot for mobile communications.

But the 5G future will look different—very different. Instead of sticking to this limited spectrum range, we are looking up—to infinity and beyond. We are going to bust through our old 3 GHz ceiling and create new possibilities for millimeter wave spectrum, or airwaves that are way, way up there. Of course, at these stratospheric frequencies there are propagation challenges. While these super-high signals carry a significant amount of data, they do not go far. But we can turn this limitation into a strength by combining these frequencies with small cells packed close together, densifying our networks at lower cost. This, in turn, can mean service that reaches further into buildings at faster speeds than ever before. This is especially useful in urban corridors and fast-growing areas with the greatest traffic demands.

I am excited about this rulemaking—and it comes at the right time. Because efforts to develop the next generation of wireless technology are already underway around the world. South Korea and Japan have plans to deploy 5G services by the time they hold the Olympics in 2018 and 2020, respectively. Last year, the European Commission committed to support 5G research with South Korea and this past May signed up for the same with Japan. Only a few weeks ago it reached an agreement with China, where three of the nation's ministries have jointly established a group to promote the development of 5G technologies. In short, the race to 5G is on.

With the race on, today's rulemaking gets us out of the gate. We propose to authorize mobile operations in the 28 GHz, 37 GHz, and 39 GHz bands. We also propose to authorize unlicensed operations in the 64-71 GHz band. This last effort is especially exciting, because it may move us from a world of Wi-Fi to Wi-Gig. With respect to the other bands we propose creative licensing and technical rules and take into consideration the need to protect incumbent federal operations and existing satellite interests. We also seek comment on additional airwaves to develop a further record to support new bands as the technology for millimeter wave spectrum advances.

Next month, we will present the ideas we adopt today to the rest of the world at the World Radio Conference. This year's conference is especially important because we have an opportunity to help decide what spectrum bands are studied for 5G. The opportunities for international harmonization are real—and with it they bring the potential for scale economies that will lower the cost of equipment and deployment. This, in turn, will speed the availability of 5G services both on our shores and worldwide. This is important—and the pressure is on.

Going forward, I think it is also important to update our policies for small cells. To win this race, we are going to need to incorporate these antennas into the designs of essential infrastructure through new building models, retrofitting practices, and certification standards. This is a discussion that is far broader than this Commission—but is absolutely necessary for the possibilities of millimeter wave spectrum to really take flight.

It's worth the effort. Because if we get our 5G spectrum policies right, we will take our success in 4G and propel ourselves forward to lead the world in the next generation of wireless technology. I look forward to making it happen.

**STATEMENT OF  
COMMISSIONER AJIT PAI  
APPROVING IN PART AND DISSENTING IN PART**

Re: *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, GN Docket No. 14- 177; *Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands*, IB Docket No. 15-256; *Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band*, RM-11664; *Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 to Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services*, WT Docket No. 10-112; *Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands*; *Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band*; *Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services*; and *Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations*, IB Docket No. 97-95

This *Notice of Proposed Rulemaking* focuses on the use of spectrum above 24 GHz for mobile operations, but it also gives us a chance to talk about 5G, or the fifth generation of mobile service. That's an important discussion to have, because there's a global push to develop this next-generation of wireless technology. However, there is no consensus definition of 5G, so discussions often veer toward the esoteric. 5G has been described as the technology that will blend the virtual and physical worlds, enable the Internet of Things to flourish, create the connected life, and/or bring the world of Big Data to the mobile space. All significant developments, to be sure.

But some of the conversation surrounding our 5G future reminds me of a scene from the TV series *Veep*. No spoiler alerts here, but Julia Louis-Dreyfus's character, Selina Meyer, is addressing a large audience when her teleprompter goes blank and displays only the phrase "FUTURE WHATEVER." She must then ad lib her way through a speech about what is to come:

Whatever we have in store cannot be known. But given time, it can be understood. The past was once the future. The future is, I should say, unknown. It is in fact unknowable. So I'm asking you to meet me at the station and join me as we board a train bound for a place called the future. We will be ready for that future whatever.<sup>1</sup>

When it comes to our 5G future, however, "whatever" isn't good enough; the time for vague generalities is coming to an end. I'm therefore pleased that the Commission is launching a rulemaking today that will allow us to start getting more specific about 5G.

This is all the more important because companies are investing heavily in engineering solutions and achieving technological breakthroughs thought impossible only a short time ago. I've had the chance to see some of those efforts firsthand. One year ago today, I visited Samsung's 5G research lab near Dallas, TX, where engineers are hard at work developing base stations and mobile technologies that use spectrum above 24 GHz. Their experiments with multiple-input, multiple-output antennas no bigger than a Post-it note have already demonstrated that 5G technologies used in those bands can deliver mobile speeds in excess of 1 Gbps. More recently, I attended Intel's demonstration of its millimeter wave technology here at the FCC's headquarters. It showed how spectrum above 24 GHz can be used to beam signals off tables, buildings, or other objects to find the most efficient, highest-capacity connection

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<sup>1</sup> See also <https://vine.co/v/euQLPa7V50m>.

between a base station and mobile user. These and many other efforts will enable consumers to enjoy the next generation of wireless connectivity.

As for the FCC's role, my view is that we should put a framework in place that will allow 5G to develop in the United States as quickly as the technology and consumer demand allow. The U.S. has led the world in 4G, and there is certainly a lot of running room left with LTE and LTE-Advanced. But we must continue to lead as mobile technologies transition to 5G. The key is to make sure that the FCC does not become a regulatory bottleneck or send signals that would lead companies to focus their research and investments outside of our country.

And on that score, today's item is a mixed bag. On the plus side, we are proposing to allow mobile operations in some bands above 24 GHz. I had called for the FCC to move quickly to take that step, so I'm pleased that we're doing so now. Moreover, I'm glad that we are seeking comment on additional ways that we can incentivize investment in these bands, including through the use of renewal expectancies when licensees meet their build-out obligations.

At the same time, I do not believe that the Commission is acting aggressively enough today to ensure that the United States becomes the global leader in 5G. In particular, the Commission is making decisions today that may needlessly delay the development of 5G technology tomorrow. I cannot support those parts of the *Notice* and therefore will be dissenting in part.

The most prominent shortcoming is the Commission's decision not to move forward on broad swaths of spectrum that might be opened up for flexible use—even though we unanimously teed up those bands in our *Notice of Inquiry* last year and the record contains robust support for moving forward on them now. Getting more spectrum into the hands of consumers and enabling more flexible use of these bands is a critical step towards ensuring that the U.S. maintains its leadership in the wireless space, and I see no downside to starting that process now. Moreover, we don't know which millimeter wave bands will prove to be viable homes for 5G or other wireless uses.

So I suggested adding additional spectrum bands to the *Notice*—including 12,500 MHz of spectrum in the 24 GHz band, 32 GHz band, 42 GHz band, and the 70 and 80 GHz bands. Unfortunately, the votes were not there, and the *Notice* does not propose moving forward on them. The Commission's decision to sit on literally thousands of megahertz of spectrum that could very well be used for licensed and unlicensed innovation is a lost opportunity.

The *Notice* offers no persuasive reason for leaving these bands on the cutting room floor. It claims, for example, that the agency is focusing only on bands with at least 500 MHz of spectrum. But the 42 GHz band offers 500 MHz. The 32 GHz band has 1,600 MHz. And the 70 and 80 GHz bands have 5 GHz of spectrum each! Besides, a 500 MHz floor is artificial and backward-looking. Nokia, which is doing a substantial amount of research into 5G, told the FCC that bands with as little as 300 MHz of contiguous spectrum could be useful sandboxes for wireless innovation. In particular, it urged the FCC to include the 400 MHz of spectrum in the 24 GHz band in this *Notice*. But we don't propose to allow mobile operations in that band, or in others like it.

Similarly, the *Notice*'s excuse that some bands lack an existing mobile allocation carries no weight. The 42 GHz band as well as the 70 and 80 GHz bands *do* have mobile allocations. And in any case, the FCC holds the pen: nothing prevents us from using this very proceeding to ink a mobile allocation for any band that lacks one.

The *Notice* also claims that certain bands are being left out because they are not part of the U.S.

and CITELE proposal that will be considered at next month's World Radio Conference in Geneva.<sup>2</sup> But if inclusion in the WRC proposal that the U.S. supports were the test, then we should have included all the bands that *are* part of that proposal—yet we fail to expressly advance a number of them in this domestic proceeding.<sup>3</sup> Indeed, nothing within the four corners of the *Notice* indicates that the FCC will *ever* move forward on those bands.

But holding back on spectrum that might be used for next-generation mobile networks isn't my only concern. The *Notice* also contains a number of proposals that are unnecessarily complex. For example, it pursues complicated licensing schemes and novel performance metrics that might require licensees to go so far as to measure the daytime population of their service areas (including tourists and transient populations, the Commission says),<sup>4</sup> and it veers into discussions about technical requirements concerning data authentication that are better left for standards-setting bodies and industry to resolve.<sup>5</sup> I worry that these proposals might be taking us down a path that will make the investment case in these bands more difficult. We recently saw how this can happen in the context of the 3.5 GHz band. There, an IEEE Working Group concluded that the regulatory framework does not justify the time or cost necessary to develop a technical standard.<sup>6</sup> For these millimeter wave bands, the engineering is going to be hard enough; the regulatory framework shouldn't add unnecessary complexity.

In sum, we should ensure that the United States becomes the leader in 5G in the years to come. To do that, we have to make the tough decisions today. While I appreciate that the *Notice* now asks additional questions about the spectrum bands we are not proposing to advance, putting these bands off for consideration in another proceeding at some later date isn't enough. We shouldn't passively hope that the "future whatever" materializes; we should take the concrete steps now that will enable engineers and innovators to develop technologies for these spectrum frontiers.

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<sup>2</sup> See *Notice* at para. 79.

<sup>3</sup> See *id.* at paras. 13, 79.

<sup>4</sup> See *id.* at para. 208.

<sup>5</sup> See *id.* at paras. 260-65.

<sup>6</sup> Comments of IEEE 802.11, GN Docket No. 12-354 (July 13, 2015), <http://go.usa.gov/3h8Eh>.

**STATEMENT OF  
COMMISSIONER MICHAEL O'RIELLY  
APPROVING IN PART, DISSENTING IN PART**

Re: *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, GN Docket No. 14- 177; Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands, IB Docket No. 15-256; Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band, RM-11664; Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 to Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services, WT Docket No. 10-112; Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations, IB Docket No. 97-95*

It is envisioned that the spectrum bands we consider today eventually will be part of the next generation of wireless services, allowing everything from lightning fast downloads of high-definition video to accommodating the future abundance of the Internet of Things. There are great expectations of what may be possible from these airwaves – increased data speeds reaching 10 gigabytes/second, latency of one-thousandth of a second, increased spectral and energy efficiency, among others. If successful, it could lead to a technological revolution I like to refer to as wireless fiber.

Although, there are no standards or consensus definition yet for “5G” services, most believe that, to obtain these benefits, it will involve multiple components, including fiber, enhancements to current networks, additional infrastructure, and, of course, spectrum. To reach this potential, the Commission must ensure that sufficient spectral resources are available.

For this reason, I am supportive of taking this next step to open up these millimeter wave frequencies to mobile use by seeking further in-depth comment on the 28, 37, 39, and 64 to 71 GHz bands. These particular bands are being pursued because they already have mobile allocations and, accordingly, it is expected to be easier to introduce mobile use in them. But let's face it, even these bands are not exactly problem free, and we have some real work to do to make them operational. Moreover, these frequencies are likely just the tip of the iceberg of what is needed to make next generation services a reality.

Like Commissioner Pai, I requested that the Commission seek inclusion of additional bands explored in the Notice of Inquiry (NOI). Even if we are not ready to determine every exact component, including detailed licensing specifics (and I am skeptical that we should be doing so for the other bands), complacency must not carry the day. Instead, we must aggressively push forward. It's the only way we will create the necessary spectrum pipeline for both future licensed and unlicensed use.

On that point, I would have preferred moving forward on allowing mobile services in additional airwaves outlined in the NOI, with the understanding that some bands may take longer to resolve. But in the nature of compromise, I will accept this portion of the item because considerable effort was made to improve the section, ask additional questions that should spur the process of opening additional bands for mobile use, and a promise was made by the Chairman to reexamine the issue soon after the World Radiocommunication Conference, which I plan on attending. Beyond these bands, the Commission needs to look even further and target additional bandwidth between 6 and 24 GHz and even in lower bands. The Commission must do so in the near term as well.

Additionally, and I may sound like a broken record, it is imperative that the Commission continues its work on removing barriers to wireless infrastructure deployment. This is obviously not an issue center to today's task, but millimeter wave frequencies, which travel less than a kilometer and can be easily obstructed by buildings, will take that many more sites. As such, this will be paramount for purposes of densification and providing the corresponding back haul that will be needed for these systems.

Although I support the bulk of the item, there are certain proposals and ideas contained in this notice with which I disagree. Instead of simplicity and utilizing what has worked for the Commission in the past, we opt for vast experimentation and licensing frameworks that are unproven and highly dubious. Why do we seem intent on tossing aside our tried-and-true spectrum auction, "bidding process options" and licensing procedures on a whim?

For instance, the item contains a hybrid licensing structure for the 37 GHz Band that is objectionable and eerily reminiscent of the contained access facility that was raised – and luckily discarded – in the 3.5 GHz proceeding. If this idea is implemented, licenses would be auctioned for the outdoor areas, but indoor and possibly other discrete areas would be reserved for property owners. I am at a loss as to why we would risk the attractiveness, "auctionability" and potential development of this band for a proposal that on its face looks like giveaway for land developers and owners.

Furthermore, the discussion regarding the future of satellite services, especially the framework that is proposed for 28 GHz and allowing satellite gateways to get co-primary status, seems to reach a conclusion before actually determining if wireless and satellite services can coexist. Additionally, the structure proposed would allow certain gateway stations to obtain co-primary status for free. Talk about a giveaway.

In another area, the discussion on bidding process options would undo almost two decades of generally successful Commission precedent on auction process and renewal format. What is the justification for contemplating a vastly different scheme? This is especially troubling given our last deviation, the 3.5 GHz "experiment," has generated extensive questions regarding the viability of the priority access licenses.

Separately, the notice also contains questions regarding network and equipment security that is unlike any security section I have seen before, and the Commission's intrusion seems harmful. Beyond major authority problems, the simple fact is that licensees have the incentive to secure their networks in order to attract and maintain customers. This section of heavy-handed security procedures should have been stricken and I don't support it.

Finally, the item seeks to impose spectrum aggregation caps. The only good news is that there is a proposal that these frequencies will not be added to the spectrum screen set forth in the Mobile Spectrum Holdings Order. While I don't support any spectrum caps, it seems particularly premature given that we do not know what these services will look like and how much spectrum will be needed.

Despite not being able to support this order in full, I would like to thank the Chairman, his team and Commission staff for their time and efforts in working with me and my office to try to get the item into a better place. Thank you.